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The Arts and Crafts of the Nations

General Editor: S. H. F. CAPENNY

THE MATERIALS OF THE PAINTER'S CRAFT

15TH CENTURY TEMPERA PICTURE

Fine preservation of the Lake on the dress of the Madonna. Probably, therefore, Madder Lake. (Property of Sir T. D. Gibson Carmichael.

Frontispiece.

c5c 751.4
L37m

THE MATERIALS OF THE PAINTER'S CRAFT

IN EUROPE AND EGYPT

FROM EARLIEST TIMES TO THE END OF THE XVIIth CENTURY, WITH SOME ACCOUNT OF THEIR PREPARATION AND USE

10

BY

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CONTAINING

SEVEN REPRODUCTIONS IN COLOUR
& OTHER ILLUSTRATIONS

T. N. FOULIS
LONDON & EDINBURGH
1910

November 1910

PRINTED BY NEILL AND CO., LTD., EDINBURGH

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A WRITER OF THE XVth CENTURY

From a MS. in the Bibliothèque Royale, reproduced from the "Ancient Practice of Painting" by Mrs Merrifield.

"I GIVE YOU THIS ADVICE, THAT YOU ENDEAVOUR ALWAYS TO USE FINE GOLD AND GOOD COLOURS, PARTICULARLY IN PAINTING REPRESENTATIONS OF OUR LADY . . . AND EVEN IF YOU BE NOT WELL PAID, GOD AND OUR LADY WILL REWARD YOUR SOUL AND BODY FOR IT."

CENNINO CENNINI, chapter 96.
(*Mrs Merrifield's translation.*)

PREFACE

While many valuable and learned treatises are to be found both in English and in foreign tongues dealing with the materials of the painter's craft in past ages, there is no book in the English language which covers all the ground and brings together the latest results of inquiry and research.

The nearest approach to a book of this kind was Eastlake's *Materials for a History of Oil Painting*, which has long been out of print, and is in many ways now out of date; while for those who wish to study a particular method, nothing can surpass Mrs Herringham's recent translation of Cennino Cennini, but she confines herself to one aspect of the subject.

My aim, therefore, is to bring together within a reasonable compass the information scattered in many places, along with the results of various analyses and experiments carried out by myself, with the view of throwing further light on the more difficult

and as yet unsolved problems for the artist and the connoisseur; and to give such an account as may prove of interest to the general, though cultured, reader, with sufficiently detailed and practical information to enable a painter of pictures to repeat such methods as are accurately known, and with such exact experimental information as may open the road to further researches.

The interests of architects and of those engaged in the practical crafts, such as house painting and decorating, have also been considered, and some of the old processes which I have described, such as the use of marble-dust plaster, are worthy of their serious study; while I believe that if they would collect the traditions still existing in the workshops, they could solve many of the problems which trouble the painter of pictures to-day.

At the same time I have tried by appropriate description and quotation to reproduce the atmosphere, where possible, in which these ancient works were carried out.

It is to be hoped that something of interest will be found in the book for many different kinds of readers, and that they will remember that this is the first attempt in this country to bring together within reasonable compass the varied information

on a subject which is, in more than one aspect, of absorbing interest.

Of the translations quoted in the book, those from Cennino Cennini have either been taken direct from Mrs Herringham's translation, or from Mrs Merrifield's, corrected by reference to Mrs Herringham; and I must thank Mrs Herringham and Messrs Allen, her publishers, for their permission to quote so extensively. The translations of Theophilus are taken from Hendrie's edition, with the exception of the translation of the beautiful opening chapter of the third book, which I have myself ventured to render into English.

Thanks are due to Miss R. F. Forbes for her translations of Pliny, Vitruvius, and de Mayerne: and to Messrs Dent, the publishers of the technical part of Vasari's *Lives of the Painters*, translated by Miss Maclehose, and edited by Professor Baldwin Brown; and to Messrs Macmillan, publishers of the *Pre-Raphaelite Brotherhood*, by the late Holman Hunt, for permission to quote from these books. I am also much indebted to Professor Baldwin Brown for help and assistance in many ways; to Sir T. D. Gibson-Carmichael for permission to reproduce the picture of a Madonna and Child belonging to him; to the Abbé Henri Breuil

for permission to copy his drawings of the palæolithic fresco at Altamira; and to Messrs Bruckmann for permission to photograph their reproduction of an Etruscan fresco; and to the various authorities to reproduce pictures in our public institutions.

In conclusion, I have a suggestion to make to those who are engaged in studying the history of art. The more I investigate the facts about the Van Eyck pictures, the more I am disposed to think that the usual view that the Van Eycks were the originators of a new technical method is wrong, and that, on the contrary, they and their immediate followers represent the culmination of a traditional Northern technique involving the use of some preparation of varnish, just as we may regard Fra Lippi and Botticelli as representing the culmination of the tempera technique in Italy.

A. P. LAURIE.

August 1910.

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The Materials of the Painter's Craft

CHAPTER I

INTRODUCTION

The use of pigments for ornamental purposes is probably one of the earliest forms of decorative art, as many of the materials were available to the artist without any special preparation. For a white pigment he could make use of chalk or other white earths, while charcoal supplied him with a black where a native black chalk was not known, and red and yellow ochres could be found abundantly in many places, and terre verte or green ochre was also available. Moreover, many of these pigments, from their soft and clay-like consistency, required no special preparation, and if merely smeared on the walls of a cave would adhere to the surface for a long time ; so that the primitive painter would have to his hand many of the necessary materials.

Such painted decorations, however, would be far from durable, and therefore, while carvings in stone and works in precious metals remain to us, the remnants of such early efforts at painting must in most cases have perished. But not in all cases, as has been proved, for instance, by the discovery of frescoes drawn by palæolithic man in the caverns of Altamira in Spain.

These drawings have been executed with boldness and skill in black, and in red and yellow ochres, and represent with great perfection many animals practically extinct in Europe, such for instance as the bison ; so that an artist of high technical skill, living in palæolithic times, has left us a record of the animals with which he was familiar in the surrounding forests.

These drawings have been most beautifully reproduced by the Abbé Henri Breuil and published by the Prince of Monaco, and with the kind permission of the Abbé one is copied here. But such traces of our primeval ancestors' skill in drawing are rare, and it is necessary in searching for later examples to come to the times just before the dawn of the historic period in Europe and in Egypt.

In Europe we have the Etruscan frescoes, many of which are of great beauty, and we have also the

PALAEOLITHIC DRAWING, ALTAMIRA

In black, and red and yellow ochres

frescoes discovered in the palace of Knossos in Crete. The excavation of this wonderful palace has revealed the existence of a high civilisation of which we have no indication in the known history of Greece, the later palace dating probably somewhere about 1500 B.C.

The wall-paintings in this palace have several peculiarities. The plaster is in three layers; the lower layer, of coarse rubble, lime and clay, is some one and a half inches in thickness; above this the fine plaster was laid in coats, the first about half-an-inch and the second a quarter-inch in thickness.

This fine plaster consisted apparently of lime without any intermixture of sand or marble dust, though possibly it had been allowed to remain slaked for a long time before use.

Upon this surface the pigments have been laid without any binding material, but they are firmly adhering, and must therefore have been painted on the wet lime surface.

The pigments used are black chalk, yellow and red ochres, lime for white, and for blue the Egyptian blue frit, of which we shall have to speak later. It is thus highly probable that commercial relations existed between Crete and Egypt when this palace was decorated, about B.C. 1500.

To pass from Europe to Egypt, we have to go to much earlier dates to find the remains of a prehistoric civilisation due to an earlier race. Flinders Petrie puts the date of the prehistoric period in Egypt at from 8000 to 5800 B.C. Not only are tomb frescoes of this prehistoric period known, but prehistoric slate palettes and mullers have also been found which were used for rubbing down pigments. Egyptologists have decided that these slate palettes were used for preparing pigments for decorating the face; but to whatever purposes the pigments were applied, they evidently required to be rubbed down with some convenient medium, and on one of the palettes are to be seen traces of the pigment which had been ground upon it.

In addition to these natural earths which would form the first pigments used by the painter, the discovery of red veins of cinnabar and blue veins of copper carbonate would add to the materials at the command of the artist. It would be long, however, before these natural pigments were increased by the addition of those from artificial sources, and it would only be as other arts developed that the artist would get the advantage of various chemical and metallurgical discoveries. For instance, the development of the potter's art and the discovery

of various coloured glazes would naturally result in the attempt to use such glazes ground fine as pigments. An interesting example of a development of this kind is to be found in Egypt.

The use of glazed quartz, and glazed vessels having a porous siliceous body, was known in Egypt in prehistoric times, and the prevailing colour of the glaze was blue to green, owing to the addition of copper compounds.

Later on we find the famous Egyptian blue used in painting. This blue on analysis proves to be merely a richly coloured copper glaze ground to a fine powder, the artist in pigments thus benefiting by the inventions of the craftsman in glazing.

Discoveries in connection with mining and metallurgy would also result in adding fresh pigments to the artist's colour-box. The cinnabar, for instance, and the blue copper ores already referred to might come before the painter's notice, owing to the treatment of these substances for the production of copper and quicksilver, while the discovery of how to prepare lead from its ore was necessary before red lead could be manufactured, and the additional discovery of the results of the fermentation of the grape and the production of vinegar before white lead and verdigris could be added to the list. The painter

also owes much to the art of the dyer. The discovery that certain herbs could be used to dye textile fabrics, and that certain agents could be used as mordants to fix these dyes, would naturally lead to the attempt to fix the dyes upon some white chalky ground and so utilise them for painting; and we consequently find that the most famous dye of classical times, the murex, or royal purple, was also used to prepare a pigment for the artist. It is impossible to say which of these many discoveries may have preceded the other, and whether the attempt to make a pigment from the vegetal dye preceded the attempt to use it for dyeing the textile fabric; but, at any rate, the artist has throughout been able greatly to increase the number of pigments at his command as the sister arts have developed, while at the present day the discoveries of modern chemistry have added many valuable, and also many treacherous, pigments to the artist's paint-box. It is, therefore, not surprising to find in the earliest historic times that complex decorative schemes could be carried out with a great variety of colour. The necessity of fixing the pigment to the surface would also naturally lead to the investigation of possible mediums which could be mixed with the pigment and used to attach it. In Egypt the acacia supplies

gum arabic, which only needs to be dissolved in water to form a convenient medium. Egg has also formed an obvious and useful medium from very early times, and the discovery of how to prepare glue, while of importance to the carpenter, was also of importance to the artist. The natural semi-liquid balsams or resins obtained from trees, beeswax, and the tar prepared for ships all obviously lend themselves to being mixed with pigments and applied to various surfaces. The most useful medium of all, however, which is the basis of most modern painting, the vegetal oils that have the property of hardening when exposed to the air, seem to have been utilised comparatively late, and were not at the command of the artist at the beginning of things. It is evident, therefore, that in looking into the history of the painter's materials we are led to consider some of the sister arts and crafts; and while it is impossible to develop fully these interesting sides of the subject in a book of this length, some passing references will be made.

The subject may well, however, be regarded in another aspect; for, while leading on the one hand to a consideration of such sister arts as the enamelling of earthenware, the dyeing of fabrics, and metallurgical processes, it is also connected on the other

hand very closely with the æsthetic development of painting. It is not the purpose of this book to enter into so difficult a subject; but in order thoroughly to understand the artistic development of any period, we should be familiar with the pigments and with the mediums actually in the possession of the artist. Each medium leads inevitably to certain modes of expression—modes of expression which are limited in some directions, and which can be extended in others, and so, as the art progresses, the artist is inevitably guided along certain channels. To give an instance, the fifteenth century doubtless saw the final and most perfect product which was possible with the tempera medium, a product distinctly different from what is possible with oil, and again different from what can be done with a water medium of the nature of gum. If, then, we compare on the one hand the finest work of the Italian tempera painters of the fifteenth century with a modern water-colour and a modern oil-painting by a great master, we shall realise how, in each case, the medium used has inevitably led to certain definite forms of expression by the artist. It may therefore well be that a medium different from that in common use may long be known and yet not be utilised because the artist is already satisfied with the materials which he has been trained

to use and does not feel drawn to search for a new mode of expression. To give an obvious example, the use of oil for painting was known at least as early as the time of Theophilus, and, judging by the accounts at Ely and at Westminster, oil must have been used very early in connection with the decorative painting in the English cathedrals. Yet it was long before the possibilities of this new medium were realised by the artist. It is certainly open to question whether even the Van Eycks, though usually regarded as the inventors of oil painting, can be considered as really having painted in oil. It seems more probable that their pictures were begun in tempera and glazed with a medium containing some oil, and can therefore hardly be classed as oil paintings. It is also probable that they were influenced in departing from the egg medium by two considerations. In the first place, a damper climate made tempera pictures much more perishable than in Italy, even if protected by varnish; and, in the second place, the desire to get transparent, brilliant, glazing colours would lead to the attempt to produce a medium of the nature of oil or varnish. The magnificent greens, for instance, which are to be found in Van Eyck, and some of those that followed after him, are not seen in the tempera pictures. It is therefore highly

probable that the new line of development lay along the direction of, in the first place, varnishing the tempera picture, and then discovering the brilliant effects to be obtained by grinding the more transparent pigments in the varnish, or, in certain cases, actually dissolving them in the hot varnish, and laying them over the solid tempera painting beneath, thus combining the permanent water-protecting surface of the varnish with the new and brilliant effects to be obtained from transparent pigments ground in the varnish medium. It is not till some time after that oil practically pure, or mixed with a little varnish, is freely used by the artist, and that its great possibilities of expression lead to the complete disappearance of the tempera medium.

It will be seen, then, from these few remarks that while the subject of the materials used by the painter may seem, at first sight, to be one of limited interest, yet it is closely connected on the one hand with the development of all the sister crafts, and on the other hand with the æsthetic expression which the painter has been able to obtain at various times in the history of the art. There is also a third point of view from which the subject may be considered, namely, as throwing light upon the conditions of civilisation existing at various periods. It may seem strange

at first to go to a collection of receipts and directions for painting to get fresh light on the intimate lives of former generations, but the student seems to get more closely into touch with the lives of the people when engaged in studying a collection of receipts obtained from a painter's manuscript, than when reading of great historical events. Wars and political movements have always a certain similarity, and differ little from age to age except in the ingenuity of the weapons used for carrying out the purposes of the warrior; but in the little details which are to be found in the receipts for preparing a pigment or purifying an oil, we seem to get an insight into the whole life of the artist, and get closely into touch, not only with the domestic conditions and the development of the crafts, but even with his outlook upon the world. The trite moral reflections scattered throughout Pliny's *Natural History*, the deep and childlike piety of Cennino Cennini, and the reckless brutality of outlook combined with the sincerest loyalty to his craft of Benvenuto Cellini, are all of fascinating interest to the student of human character as it is modified by environment at each stage of the world's history. The mere statement, in a receipt obtained from some monkish manuscript for the preparation of a pigment, that the decoction is to be

allowed to boil while ten paternosters are recited, throws a vivid light upon the lives of the monks and their whole attitude towards the crafts on the one hand and towards religion on the other. In fact, on every hand, as we study that apparently dry and mechanical side of the painter's art, we shall find fresh suggestions throwing light on many things of the greatest interest.

It is, of course, impossible in a little book of this length to treat the subject exhaustively. Many volumes would be required to discuss fully the various processes used at different times, and to bring before the reader all the arguments for and against a given conclusion. At the end, in spite of the large amount of material that lies to hand, many of the most interesting problems have not been solved, and the best that can be done is to point to probabilities. To take an instance, the durability of many of the early "oil" pictures has always been a puzzle to the modern artist. The perfect freshness of a Van Eyck, as compared with the desperate condition of many a picture painted only a few years ago, is very difficult to understand, and at the end of all the light that modern science can throw upon the question we have to admit that the secret of Van Eyck has perished with him, and that he had a mastery of certain techni-

cal processes which has resulted in a durability of workmanship which to-day we cannot imitate. The secret of this profound technical knowledge lies in the fact that the artist of earlier times was also a craftsman. He built up his picture from the beginning; he knew intimately how to prepare his panel, how to make many of his pigments, how to purify them, grind them, and prepare his mediums and varnishes. During his apprenticeship he was trained in these various processes just as a modern carpenter or blacksmith is trained in every detail of his craft; it was his business while an apprentice to prepare all these things for his master, and in that way a tradition was built up in which what was faulty was rejected and only what was reliable retained. Moreover, it was the object of the early painter to produce a good and durable job. He was not merely thinking of the æsthetic result of his labours. He was trying to turn out a good piece of workmanship that would stand the test of time, and to this end many of his operations were directed. Unfortunately, he was content to teach his apprentices verbally, and it is only here and there that the artist himself has left a record of the processes that he used, while many of the existing manuscripts contain bundles of receipts which have accumulated through the ages and which

have been thrown together by the compiler without any care as to which were of practical value and which were useless, so that in one sense we are bewildered by the amount of material, the difficulty being to select from among it what is really good from what is bad. The modern artist is merely thinking of the æsthetic result; he expects all these base mechanical operations to be performed for him by the manufacturers of canvas and oil, varnishes and pigments; and the result of this divorce between the humbler and the higher duties of the artist has been disastrous to the permanency of his work. If we wish to find any of the traditions of the medieval studio we need not look for them in the Latin Quarter or in Chelsea. They are to be found more often in the workshops of to-day. The house-painter and the coach-painter, the frame-maker and gilder, are the people among whom some of those old traditions still linger, and where a careful inquiry would probably result in some very striking and interesting discoveries. The whole subject, therefore, is surrounded by much doubt and difficulty, and it is impossible in a short book to discuss fully all the arguments for and against a given conclusion; and many parts must be left undealt with, while those are selected which seem of most interest and of the greatest im-

ETRUSCAN FRESCO. TOMBA DELLE LEONESSE, COMETO-TARQUINIA.
(F. BRUCKMANN, MUNICH)

portance. It may also be necessary occasionally to be too dogmatic and to make an assertion which some other writer might be disposed to criticise. At the best, therefore, only an attempt can be made to place the main facts before the reader, and to explain to him as fully as possible the conclusions which are most probably correct.

CHAPTER II

THE PIGMENTS AND VEHICLES USED IN EGYPT

It is not our province here to discuss Egyptian art, but rather to confine ourselves to the materials used for painting purposes. But in order to understand those materials we must know something of the conditions of life in Egypt.

The delta of the Nile is surrounded by deserts on two sides, and for a long period in Egyptian history a region of extensive swamps lay between the cultivated, civilised regions of Egypt and the sea, so that an isolated civilisation grew up, which only by degrees began to draw materials from the outside.

Within the country itself wood was always scarce and the flora very limited in variety, while the surrounding deserts were practically sterile. There were, consequently, no trees, as we shall find, in the near neighbourhood that would yield resins suitable for varnishes. One tree, however, grew freely, the

acacia, and grows freely to-day; and consequently, as has been already pointed out, gum arabic could be had in abundance. The papyrus reed, which is no longer to be found in Egypt, grew plentifully in the swamps of the Lower Nile, and, while serving many purposes, also supplied, as we shall find, the material for paper.

Of natural pigments we find from the earliest remains that the ochres were used, though I am not aware that the source of supply has been identified. Such ochre deposits are, however, very widely distributed, and may well exist in some of the surrounding sandstone and limestone formations. For the copper ores which were the basis of their blue and green glazes and blue and green pigments they had to go further afield to the mountains on the west side of the Sinaitic peninsula in the Wadi Nasb and the Wadi Maghara, while the gold for gold leaf came from the gold mines in Nubia.

Commercial relationships were comparatively early opened up with Syria and with Arabia, from which various products might be obtained, and the analysis of the pigments found in the palace of Knossos goes far to prove commercial relations with Europe as early as 1500 B.C., and therefore long before the date at which the Greek civilisation which we know comes

from the region of myth into that of history. We must therefore expect to find in later times the means of obtaining from various sources any materials likely to be of use in painting.

The early production of linen in Egypt shows that the flax plant must have been known and cultivated from the earliest times, but there is no trace of knowledge of how to extract from the seed the linseed oil, or of any knowledge how to utilise its drying properties as a varnish or painting medium. It must be remembered in this connection that the extraction of oil from the olive or the walnut is comparatively easy, and that the linseed does not readily yield its oil to treatment. When in the eleventh century processes for its extraction are described, they are the same as those used at the present day: crushing, heating, and then squeezing in heavy presses while still hot.

The Egyptians very early in their history developed great skill in glazing, and this has already been referred to. This glazing was not done on ordinary earthenware, but either on quartz or stone, or on a specially prepared siliceous body. For further information the reader is referred to *Arts and Crafts of Ancient Egypt*, by Flinders Petrie.

The connection between the pigments used by the

artist in painting and those used for glazing ware is fairly close, but is apt to lead to misunderstanding if not clearly grasped. It is evident in the first place that pigments which will stand a high temperature in the furnace are available for the glazing of pottery. Consequently we find the pigments which owe their colour to iron, like the red ochre and hæmatite, available for the potter; but on the other hand yellow ochre is useless, as it is on heating converted into red ochre, and he must therefore obtain his yellow by some other means. Another case in point is the cobalt blue, cobalt being available as a source of colour both to the potter and the painter, though apparently the use by the potter of this pigment is very old and by the painter comparatively recent. There are also certain substances which, when combined and fused into a glass, develop in the heat of the furnace a colour which they do not naturally possess, and one, therefore, not found on the artist's palette.

In conclusion, the coloured glass or glaze of the potter may be prepared by itself for use as a pigment, as in the case of the Egyptian copper blue, to be shortly more fully discussed.

The art of dyeing was evidently very early understood, though they seem to have preferred to bleach

their beautifully fine linen and wear it white; and they must therefore have cultivated or obtained from elsewhere the necessary plants.

In the introductory chapter I have discussed briefly the way in which the artist's list of pigments gradually grows, and incidentally I have taken one or two examples from the facts known as to the pigments used in Egypt.

We have now to consider more particularly the pigments and vehicles in use in that country. In order, however, to understand thoroughly the processes which we shall find in use, we must remember the conditions resulting from the Egyptian climate. The dry, warm air usually prevailing made it an easy matter for the artist to obtain durable results. He had not to fear the destructive effects of moisture upon his work. Moreover, much of his work was permanently sealed up in the tomb, and has naturally remained practically uninjured by time. There was no necessity, therefore, to invent an oil medium or to use a varnish, though varnishes were used at one period, or to make use of beeswax, although we shall find beeswax in use at any rate in Roman times, and possibly earlier.

Three kinds of painting were common: the painting of wall surfaces, the painting of the coffins enclos-

Reproduction from portion of Egyptian Book of the Dead. (Papyrus of Ani, British Museum.)

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ing the embalmed bodies of the dead, and illuminating with pictures the text of papyrus manuscripts. In all three cases the painting was of a similar character, and decorative in its object, and, while requiring accurate drawing of outline, not involving much subtlety in the handling of the pigment and the medium.

The painting of the wall surfaces was done either directly on the smooth stone or on a layer of plaster laid on to cover up irregularities in the stone surface; and the plaster itself seems to have been a mixture of lime with plaster of Paris. Not only were the walls of the tombs thus made smooth, but brick buildings were covered with a thin coat of plaster, and even the statues were similarly treated as a basis for subsequent painting.

On this surface fairly solid painting was executed with some convenient medium. One useful medium was easily obtained in Egypt, namely, gum arabic, which exudes from the acacia, a tree which grows freely in Egypt. To use this it was merely necessary to dissolve it in water.

The preparation of glue was also early known, and glue was evidently used largely as a painting medium.

It is also quite probable that egg, both the white

and the yolk, would also be used. None of these mediums will, of course, withstand the attacks of water; and if any Egyptian wall-paintings will, as is stated by Herr Berger, withstand the action of water, then some other medium than these must have been used on some occasions. Probably wax, or a mixture of wax and resin, would be used in such cases. There would be no difficulty in applying melted wax to wall surfaces in so warm a climate, though its durability might certainly be open to question.

In many of the older wall-paintings *in situ*, and still more in the case of those which have been removed to the museums, it is no longer possible to judge of the original condition of the medium, as they have too often been treated in various ways. In some genuine samples from a freshly opened tomb of the XIXth dynasty which I obtained from Professor Baldwin Brown, the pigment was quite easily removed with a wet finger, and on analysis proved to be attached by means of gum.[1]

Something has already been said about Egyptian pigments, but they must now be considered in more detail. The paintings show the use of red and yellow

[1] An oil-like residue was also present to the amount of about 10 per cent. of the gum, 2 mgm. combined with the lime. This is interesting because of Herr Berger's theories.

ochres, a dull green, occasionally a bright green, and a bright and beautiful blue. This blue is the Egyptian blue already referred to, but now requiring to be considered in some detail. As has already been explained, this blue is a copper glaze, glass, or frit, and probably originated in the glazing of pottery and the discovery that such a glaze pounded down results in a blue pigment. Vitruvius tells us that the blue is made by fusing together sand, soda, and copper, and that it was originally made in Alexandria, and is now (the time of Augustus) manufactured in Puteoli. The references in Pliny are somewhat obscure, and he seems to be referring to the same pigment under different names. Theophrastus also somewhat obscurely seems to refer to it under the name of an artificial cyanos. Those references to "cyanos" I shall have to mention more fully presently. The blue is easily identified on a fragment of fresco, appearing under a moderate power of the microscope as consisting of brilliant blue, transparent, glassy fragments, and yielding under the blowpipe the usual tests for copper. The analysis of samples reveals usually the presence of some lime and alumina, besides silica, soda, and copper. Professor Russell has succeeded in preparing not only a beautiful blue of this kind, but also a green.

A fragment of painting on stone in the Museum at Edinburgh, of the XIth dynasty (3500 B.C.), where strips of red ochre and the copper frit are alternately laid on, shows how early this blue was known, the invention, according to Theophrastus, of an Egyptian king.

It was used not only in Egypt, but also in Rome in imperial times, as the universal blue for fresco-paintings. Its revival for fresco-painting might well be considered, both because of its beauty and its durability.

It is also a curious and interesting fact that, although this pigment was no doubt suggested by the blue glaze, due to copper, there is no trace of a pigment prepared from cobalt, though cobalt has been detected in certain blue Egyptian glazes. The greens already referred to seem to be usually mixtures of this blue with a yellow pigment, such as yellow ochre, or, according to the analysis of John, with a yellow vegetal lake.

In the introductory chapter I explained how pigments were probably suggested by the art of dyeing, such pigments, made by staining and fixing with a mordant on a white base a vegetal or animal dye, being known to artists as lakes. The lakes to which artists of to-day are accustomed, such as madder lake

and crimson lake, are usually made by fixing the dye on a translucent or almost transparent base such as alumina; but the lakes of Egypt and Rome were usually fixed on chalk or gypsum, and formed therefore opaque pigments. It will readily be understood that it is not enough to mix the dye with the chalk or gypsum, the staining colour readily washing out. The dye must be fixed on the gypsum just as it must be fixed on the cloth, by means of a fixing agent or mordant. Such a yellow vegetal lake is described by the chemist John as having been found on an Egyptian fragment.

But in addition to green prepared in this way, it is quite possible that a green copper frit was also used; and in the case of one fragment of a piece of painting on a coffin I once reported on for the late Professor Middleton, a green copper frit was present. Among the reds, red ochre has already been referred to; but in addition Professor Petrie found a pink-coloured pigment, which on examination by Professor Russell was found to owe its colour to madder.

The use of the root of the madder plant for dyeing is very old, and it is clearly described by classical writers, and is also mentioned as yielding a pigment. The preparation, however, of a madder lake

is by no means a simple matter, and there is very little reference to madder lakes in medieval times. The discovery of an actual Egyptian madder lake was therefore all the more interesting. This lake was of course of the opaque variety, as already explained, and prepared on a gypsum base. Professor Russell succeeded in reproducing it by boiling together madder root, gypsum, and a little lime, an entirely novel receipt to the modern colour maker.

These pigments, along with charcoal for black and possibly orpiment, seem to be the principal pigments used in purely Egyptian times.

The method of painting on walls has already been considered, though evidently further light is required on the medium used for this purpose; and it remains to consider next the painting on coffins. The coffin might be made of wood, or of strips of linen pasted together, or in later times of strips of papyrus.

Before being painted on, the surface was covered with a thin coat of gesso, consisting of chalk mixed with glue. In the case of one fragment I have examined special means were adopted to attach the gesso firmly to the wood below. This was a matter to which, as we shall find later, much importance was attached by the Italian painters of the fifteenth century. In order, then, to attach the gesso, the sur-

face of the wood had been torn or scraped up and then laid over with a mixture of sand and glue through which the fibres of the wood still attached were mixed, and on this bed of sand the fine gesso was spread.

The other fragment I examined, of about the XIXth dynasty, may be described more fully.

Over the wood was laid a white gesso, and this had been painted with black, and with an apparently stencilled pattern of yellow ochre. Over the whole of this had been laid a reddish-coloured varnish, which was in places in excellent condition. On treating with alcohol the varnish at once dissolved, leaving the painting underneath unaffected. The black pigment was found to be powdered charcoal ; and the yellow, a yellow ochre containing white coarse fragments apparently of quartz. It had therefore not been treated according to the modern method of preparation, that is, of grinding the crude ochre from the mine with water, mixing it with a large volume of water in a vat, letting the coarse particles settle, and then draining off into another vat, in which the fine particles for use as a pigment are collected. The gesso was composed of chalk.

On boiling the painted surface and gesso with water after removal of the varnish, it was completely

disintegrated, so that there was no indication of a medium like oil or wax, insoluble in water; and in evaporating down the water solution after filtration, a residue of translucent brown plates was left. The brown plates were of animal origin, and, while not giving all the reactions of glue, are apparently glue which had become slightly modified by time. Whether any other medium besides glue had been used to lay the pigment on the gesso surface it would be impossible to say. The gesso itself was certainly composed of chalk and glue.

The use of varnish described above is, I believe, limited to a period of about the XIXth and XXth dynasties (1300 B.C.), appearing about that time and then being given up again in later times.

The presence of the varnish gives rise to some very interesting questions, which in order to explain will necessitate our considering shortly how varnishes are prepared.

In the first place, the bases of all varnishes are various resins known to commerce. Some of these resins are obtained from living trees; others are found by digging or mining, and are the resins of the trees of old forests. Such fossil resins are amber, the harder copals from Africa, and Kauri resin, now exported from New Zealand. The resins of living trees

are familiar to all, and may be seen exuding from the bark of a pine tree. These resins exude from the trees in a treacly condition, the hard solid resin being dissolved in the volatile oils of turpentine. If, for instance, a larch is tapped, the semi-liquid resin exudes, and is known as "Venice turpentine." If this semi-liquid resin is placed in a still and heated, spirit of turpentine passes off and can be collected from the worm of the still, and the solid resin, the common rosin of the shops, is left behind. Although all the resins, then, must originally leave the tree in a semi-liquid form, they come into the market usually in a solid form, having lost their spirits of turpentine or similar essential oils.

Such resins are common rosin, from certain species of pine trees; mastic, from the *Pistacia lentiscus*, found in Syria; and sandarac, from the *Callitris quadrivalvis*, found on the Mediterranean coast of Africa; and many others.

In order to prepare a varnish from the resin, two ways may be followed. Either the resin is dissolved by heat in a volatile medium, like alcohol (spirits of wine), turpentine, or petroleum, or it is dissolved in a drying oil like linseed oil. If dissolved in a volatile medium, it is called a spirit varnish, and on painting over a surface the spirit evaporates and leaves a solid

glassy layer of the resin behind; or if dissolved in linseed oil, it is known as an oil varnish. Linseed oil has the property of absorbing oxygen from the air and becoming converted into a transparent elastic solid. This process is usually called by the misleading name of drying. An oil varnish, then, results when dry in a film or layer composed of the resin and the linseed dry oil intimately combined. Such a varnish is tougher, more elastic, and less easily injured mechanically than a spirit varnish.

An apology is perhaps due for this somewhat long digression on the nature of varnishes, but the subject will constantly be coming before us again, and, for those who are not familiar with it, must sooner or later be described.

In conclusion, a semi-liquid resin, or balsam, as it is sometimes called, can be used directly as a varnish as it comes from the tree, on being warmed. A solid resin, if fused by heat, cannot be spread on a surface properly, and at once cracks on cooling. It must therefore be dissolved in a suitable medium as already described, or mixed with a little beeswax.

The varnish on the coffin already mentioned had not the properties we associate with an oil varnish, and was too transparent to have been mixed with beeswax. As such volatile mediums as alcohol, tur-

pentine, and petroleum were almost certainly unknown in ancient Egypt, we are driven to conclude that this varnish was a natural semi-liquid resin as obtained from the tree, like our Venice turpentine or Canada balsam, probably laid on after warming. Egypt does not, and apparently did not, possess any resin-producing trees, and therefore the interesting question is, from where was it obtained? In its properties it agrees neither with pine resin, which could have been obtained from Europe or Syria, nor with mastic, which could have been obtained from Syria or Africa, nor with sandarac, which could have been obtained from Africa. On the whole, it is most like pine resin in its properties, which may have become altered through time, and therefore was probably obtained from Syria or Europe. The reddish colour is very likely due to the introduction of a red like dragon's-blood. It is evident that a further inquiry into the nature of this varnish may throw an interesting light on the commercial dealings of the Egyptians about the XIXth dynasty.

There only remains in conclusion to consider the paintings on papyrus. These paintings call for no special remark, in addition to what has already been said, but the papyrus itself requires a word or two of description.

The papyrus reed from which it was prepared used to grow freely in Egypt, but is now extinct. It grows twelve to twenty feet high and three inches in diameter. It is full of pith. This pith was cut in thin slices, and the slices laid side by side and beaten with a mallet on a slightly sloping slab so as to allow the sap to drain off. Then they were brushed over with flour paste, and a fresh set of slices laid on at right angles to the first lot and beaten with a mallet as before. For the best papyrus this process was repeated more than once. The finished papyrus is a beautiful, luminous brown, and takes pigments most excellently, and is therefore very suitable for fine decorative treatment.

The wax portraits on panel of the second century discovered by Flinders Petrie at Hawara will be considered later in connection with classical modes of painting. The Egyptians used the *Carthamus tinctorius* (κνῆκος, Lat. *cnicus* or *cnecus*) for a dye, and probably prepared from this the yellow lake. The seeds yield an oil which they prepared, and which is a "drying" oil, but there is no evidence that they understood how to utilise its "drying" properties.

CHAPTER III

METHODS OF PAINTING IN CLASSICAL TIMES

Introduction

As we have seen in the former chapter, the Egyptian painter confined himself to the decorative treatment of wall surfaces and the gesso-prepared surfaces of coffins made of wood or papier-mâché, and the adornment of papyrus manuscripts. The designs thus executed in colour seem to have been a natural development from the bas-relief carving in stone which they had brought to such great perfection, and in fact replaced it in later times.

The painters of Greece, if we may judge by the descriptions in Pliny and the wall-paintings in Pompeii, carried the pictorial art much further, though it is open to question whether their greatest painters reached a level in pictorial art which we should regard as the natural equivalent of their skill in sculp-

ture. At the same time, it must be remembered that the Pompeian decorations are not supposed to be the work of great artists, but rather of capable craftsmen, in many cases copying probably well-known Greek pictures.

The two main sources of information as to the materials and technical methods employed, with which alone we have here to do, are Pliny and Vitruvius.

Pliny the Elder was a most voluminous writer and reader, and has left behind his *Natural History* as the monument of his labours. This can best be described as the encyclopædia of his time. Inquiry has often resulted in showing that Pliny was more accurate and more reliable than careless commentators and inefficient experimenters had supposed. His remarks on painting, moreover, are of peculiar interest, because we have as illustrations to his work the frescoes in Pompeii and Herculaneum which have remained buried beneath the ashes of Vesuvius, thus preserved for our inspection by the very eruption in which Pliny himself perished. Going himself to investigate the disaster, and being of a full habit, he died on the shore from heat and suffocation before he could reach his ship, as has been described most fully by his nephew, Pliny the Younger. So

that we have here the remarkable coincidence that the only writer on painting in classical times, whose writings have come down to us with any completeness, perished in the eruption which smothered in ashes and thus sealed for centuries the only extensive record left us of the classical treatment of wall-painting.

The other writer to whom we shall have to refer is of quite a different type. Vitruvius was an architect in the reign of Augustus, and therefore a little before the time of Pliny, and had charge more especially of the engines of war for the emperor. His book, therefore, deals with architecture, but in the course of it he treats of the decoration of plastered wall surfaces with colour, and also describes several kinds of pigments.

There is in addition some description of pigments in the work on stones by Theophrastus.

To return to Pliny: dealing as he does not only with various objects in nature, animal, mineral, and vegetal, but also with the uses to which they can be put, and the methods of utilising them, as might be expected, the commonest described are those for medicinal purposes, nearly every conceivable substance being supposed to have some medicinal value, and able to cure a great variety

of diseases. But other purposes of a more practical nature occur from time to time, along with detailed accounts of the habits of bees, of the culture of the grape, of mining for precious metals, and many other matters of curious interest.

It follows in the course of such a compilation that many substances are described which, while used for other purposes, might have been utilised by painters, though we are usually left in doubt on this point, while other substances are, we are told definitely, used for pigments.

We find, moreover, a discourse on the great painters of Greece and Rome, with some account of their styles of painting and their works, and interesting anecdotes about them, and incidentally further light on the materials used and the technical processes.

Pliny was, however, essentially a compiler. He quotes throughout numberless authorities from which he obtained his information, and necessarily, in most cases, has no practical acquaintance with what he is describing. This want of practical knowledge is unfortunately only too evident in many cases.

In addition to the authorities already mentioned, some information on oils and resins is to be found in the pages of the physician Dioscorides, and there

are brief references here and there in classical literature from which additional information can be gleaned; but it is almost entirely to Pliny and to Vitruvius that we have to trust for any light upon this curious and interesting subject.

We shall begin, then, by dealing with the information we have about pictures painted on panel in classical times.

With the exception of two probable forgeries, not a single example has come down to us of the pictures painted by Greek and Roman artists upon panel or canvas. The nearest approach that we have are the portraits already referred to, discovered by Flinders Petrie at Hawara, and supposed to be about the second century A.D. These, while to a great extent, as will be seen presently, revealing the technical methods of wax painting, and in many cases showing great vigour of treatment, in spite of certain conventions, are doubtless the crude work of the undertaker's hack, and are not to be regarded as representing the artistic possibilities of the times. It is evident from Pliny's account that the painting of pictures had been carried on for a long time among the Greeks, and that great schools of painting had arisen, and the works of the painters were evidently regarded as of equal artistic merit with the works of

sculpture, and were purchased by wealthy Romans and by the emperors to adorn their palace walls. The references given by Pliny also reveal the fact that there were many writers on art and art critics who had discussed the merits of the various schools of painters. For instance, there existed at that time different points of view, very similar to those to be found to-day, and which we label "Impressionist" and "Realistic." A skilful analysis of the actual statements of Pliny has shown it to be possible, with every appearance of probability, to detect from what writer different criticisms that he makes have come. It is not our place to consider this side of Pliny's work here, and it is merely referred to in passing as showing that painting was considered in classical times as one of the greatest and most important branches of art. It is also equally clear from the account given by Pliny that the painters were divided into two schools according to the medium which they used, just as to-day we might speak of painters in oil and painters in water-colour. Of these two schools, one made use of beeswax, and we shall have to consider shortly, with some detail, exactly how this medium was utilised; but of the other medium there is no definite information to be obtained anywhere. This, it is needless to say, has led to

many speculations, some having even gone so far as to declare that the pictures were painted in oil. It is, of course, impossible in a book of this length to consider in full detail all the arguments to be derived from a careful examination of the text of Pliny and other writers, and at the best therefore we can only give conclusions on this subject, and state what seems most probable, as it is impossible to give the space required for a detailed critical consideration to these questions.

CHAPTER IV

METHODS OF PAINTING IN CLASSICAL TIMES— THE PIGMENTS

THE two main literary sources for obtaining knowledge about the pigments used in classical times are, as already stated, Pliny and the seventh book of Vitruvius on architecture, with some additional information from Theophrastus. In addition to these literary sources, however, we have the actual analysis of Egyptian pigments, some of which have already been quoted, and of pots of paint found at Pompeii and elsewhere, and of the pigments found on Pompeian and other Greek and Roman frescoes. To deal with all this mass of information in detail, and to quote the results of the various chemists and give every reference to the texts of Pliny and others, would be tedious in the extreme. The larger number of pigments have been identified without doubt, and the fringe left of obscure references is not of enough

importance to delay us. We shall find a most excellent and complete palette available for the Greek or Roman painter in the time of the Empire.

Before, therefore, going into the question of mediums, I shall proceed to describe briefly the actual pigments that were in use. We find, as might be expected, that the earth-colours were well known. It may be necessary here to explain in passing that the earth-colours, as they are roughly called, consist of clays, which owe their peculiar tint to the presence of compounds of iron and in some cases of manganese. The rich yellow ochres are entirely stained by compounds of iron, while the siennas contain some manganese, and the umbers almost entirely owe their colour to the presence of this mineral. The red ochres also owe their colour to the presence of iron, and are in many cases native, such as red hæmatite, or they can be obtained by roasting the yellow ochres. In addition there is a green pigment known as terre verte which owes its colour to iron, and which was largely used in ancient times. It is no longer possible to get such fine varieties of this pigment as were once obtainable. These pigments merely require mining, grinding, and floating over as already described in a former chapter, and have always formed and will always form an important

part of the artist's palette, both for beauty and durability. In addition to these there are other native pigments, which, however, require more careful preparation. Many of the ores of copper are beautiful blues and greens, and of these the finest is azurite, a blue carbonate of copper, already referred to. Good specimens of azurite merely require to be ground to give a beautiful pigment, which is very suitable for painting in many mediums. It is, however, somewhat sandy in character, and does not lend itself well to painting in oil. Other ground copper ores, such as malachite, in the same way yield fine greens which are somewhat sandy in character. There are, in addition, cinnabar, the red sulphide of mercury, which is, in fine specimens, very nearly as brilliant as the artificial preparation known as vermilion; and among yellows there is none more beautiful than orpiment, the native sulphide of arsenic. There are also other tints of this sulphide of arsenic which seem to have been used for pigments. Then among the whites we have a large number of white earths, of which chalk is of course the most important. This may be said to exhaust fairly completely the pigments which can be found native, and which do not require artificial preparation. In modern days orpiment has disappeared from the artist's palette,

cinnabar has been replaced by the artificial preparation known as vermilion, and the copper blues have quite ceased to be used. It is evident from Pliny's account that all these pigments were well known in classical times, and the next point of interest is how far artificial pigments were known and manufactured. There are certain descriptions in Pliny which are obscure and difficult to follow, and therefore it is not possible to identify all the pigments used in classical times, but at any rate a large number of them can be clearly distinguished. White lead, for instance, was prepared very much in the way in which the best English white lead is prepared to-day, by the corroding action of the vapour of vinegar and the carbonic acid gas of the air upon lead plates, the white corrosion formed on the surface of the lead being collected and washed and used as a pigment. It seems also from Pliny's account that white lead was used as a face powder, so that it is evident that its deadly qualities were not then understood. In the preparation of lead from its ores and of silver, the discovery of the various oxides of lead had evidently been made in Pliny's time, as he describes more than one of these, and among them evidently red lead, which has also been identified on Roman frescoes. There is some confusion obvious

in his account between red lead and vermilion, the word *minium* being applied by him to the vermilion; but the existence of the pigments is without question. The preparation of verdigris by the action of vinegar on copper was also known, and the beautiful Egyptian blue has already been referred to. As has already been stated, Pliny's accounts of this blue are very vague, but it is clearly described by Vitruvius.

In addition to these mineral pigments, the use of dyes for the preparation of pigments was evidently well understood, and many of the commoner vegetal dyes were obviously in use, such as weld, woad, and madder. They seem to have been accustomed to stain chalk or gypsum with these dyes, and so to prepare lakes. The description of such a madder dye from Egypt has already been given, and also the fact that the chemist John has discovered the use of a vegetal yellow lake in Egypt. Pliny speaks of dyeing some of the mineral pigments with a view to enhancing their colour. It is possible that this may have been done, but it is not very probable. In addition to these dyes there are two others which require to be mentioned. One of these is the famous murex, the shellfish from which the imperial purple dye was obtained. Vitruvius speaks of

thickening this with honey, and Pliny speaks of its being precipitated by means of a white earth which was used for the cleaning of silver, and which was probably infusorial earth, as this earth has the property not only of absorbing certain liquids, and therefore forming the basis of dynamite, but also of absorbing and fixing certain aniline dyes, and it may well be that it also had the property of taking up the murex purple. Pliny speaks of it as having a greater attraction for the purple than wool. The use of dyes, of course, involved the knowledge of mordants, and Pliny describes at great length a substance of the name of alumen, which, if it was not our modern alum, must have been some similar aluminous compound. The next dye which requires to be referred to is kermes. This dye is due to an insect of the same kind as the cochineal insect, which lives on the prickly oak round the shores of the Mediterranean, and forms dry, hollow red berries in appearance. This was used both for dyeing and the preparation of pigments in classical and medieval times, and it is not until the introduction of the cochineal from Mexico after its conquest by Cortes that kermes begins to be replaced by the more brilliant cochineal. Its use has been revived in recent times for dyeing tapestry by the late William Morris. Blacks were

prepared either from lamp-black by burning resins and fats and collecting the smoke, or from charcoal, or apparently from bones. Pliny tells us that painters have been known to go so far as to dig up half-charred bones from the sepulchres for the purpose of making black. Pliny also mentions the preparation of black from dried vine-leaves and from grape husks, both of which are known to give a black of fine quality at the present day. In addition to these substances, there is a reference in Pliny which is quite unmistakable to the use of indigo, which, he tells us, can be obtained either from the scum of the dyers' vats, which would mean the dyers who were using woad, or from India, and he describes its properties with such exactness that there can be no question that indigo is the substance referred to. We must therefore suppose that at any rate in the first century A.D. indigo was exported to Rome from India. In conclusion, there is another reference which is supposed to be to the red resin which is used for colouring varnishes, and which was known as dragon's-blood, and which also comes from the East. This reference is of so quaint a character that it is worth quoting. In the eighth book of his *Natural History* Pliny describes the antipathy between the elephant and the dragon, stating that they

are perpetually at war, and that the contest is equally fatal to both, as the dragon envelops the elephant in its coils, and the elephant, vanquished, falls and by its weight crushes the dragon. The whole details of this contest are given at some length. Again, in book xxxiii., chapter xxxviii., when describing red pigments, he tells us that the name cinnabar should properly be given to the thick matter which issues from the dragon when crushed beneath the weight of the dying elephant, and is mixed with the blood of either animal. Again, in one of his moralising moods, in book xxxv., chapter xxxii., he compares the limited palette used by older Greek painters with the craze for brilliant colouring in the modern Rome of his day, which, while no pictures of high quality, he tells us, are produced, yet results in India sending the slime of her rivers (supposed to be a reference to indigo) and the corrupt blood of her dragons and her elephants. Sufficient has now been said of the pigments available to the artist in classical times. It will be noted that the palette is very complete, and differs little from that which was used up to the dawn of modern chemistry. There is only one pigment, and that one of the most beautiful and valuable in the eyes of the medieval painters, viz. ultramarine, extracted from lapis lazuli, to which there

seems to be no distinct reference; and on the whole, after careful examination of the texts of Pliny and Theophrastus, I am driven to the conclusion that the preparation of a blue from lapis lazuli, which as we shall prove later on is no easy matter, was not known in classical times.

CHAPTER V

ENCAUSTIC OR WAX PAINTING

In the following chapter we shall discuss the method by which wax was utilised as a medium for encaustic painting ; and here it is necessary to repeat what has already been stated, that there were evidently two schools of painters : those who used a medium unknown, and those who used wax and were called painters in encaustic. In order to explain this use of wax, it is necessary for us to consider at this point what the possibilities are in the way of mediums for painting and what properties they possess. An artist's medium must be something which can be readily mixed with the pigment and yet will serve to attach it to the surface, and in addition, if possible, it should protect the pigment so attached from chemical or other injury. The most obvious mediums, therefore, are such materials as gum or glue, or egg, but none of these possess the property of protecting

the pigment thoroughly from the attacks of moisture or other chemical agents. Doubtless, though, such mediums would be found satisfactory in such a climate as that of Greece, and therefore it would not be necessary for them to search for a medium which would resist the action of water. But in another direction such a medium would be sought for, and a clue to this search has come to us from Pliny, who speaks of the painting and decorating of ships. The tarring of ships seems to have been done by means of a woodtar prepared from a variety of pine. This tar is known at the present day, and is prepared by piling up branches of the trees, covering them with turf, and setting them on fire and boiling out the resins which the tree contains, which pour out as a dark brown tar. Pliny tells us that ships were decorated with colour, and this would not be impossible with a wood tar of this character, as when laid on wood it is like a very dark brown varnish, and therefore could be mixed with pigments which would not entirely lose their colouring value. In addition we learn that this tar was mixed with beeswax before being applied to ships, and this mixture would be tougher and lighter in colour than the tar alone, and mixed with pigments would form the basis for a rude method of ship decoration. It is easy to understand

how such a method of decoration would be developed, how pictures on panel would be attempted, and how the white beeswax alone would ultimately be used and the dark-coloured sticky tar excluded. But it is also evident from Pliny that the use of beeswax for decorative purposes was approached from another direction. Sticks of wax mixed with pigment were prepared, and these were modelled upon the surface with little hot bronze instruments known as cauteria. It is evident from Pliny's description that both these methods were in use for the production of pictures in wax. In fact, he describes three methods of using wax: one with the cauterium, one with the cestrum on ivory, and the third with melted wax and the brush. The reference to the use of wax and ivory by means of the cestrum has led to endless speculation. There is only one other reference to it in Pliny, where he mentions Iaia of Cyzicus, a lady painter who was famous for her portraits on ivory by this process. Probably the process consisted of some method of engraving on the ivory with the sharp-pointed cestrum and following up the lines with coloured wax; but it is difficult to understand exactly what pictorial effect would be gained in this way, though the results may have been similar to the Italian graffito in effect. To return to the

consideration of the two other methods referred to in this chapter, namely, modelling with coloured sticks of wax, and the painting on of coloured melted wax with the brush, we find that such authorities as Eastlake and Donner rejected the possibility of using melted wax with the brush on account of the rapid cooling on the surface of the panel, and, owing to a mistranslation of the phrase, "Ceris pingere ac picturam inurere," assumed that a liquid wax medium was used which was subsequently fused on the surface of the picture. The discovery by Petrie of the wax portraits at Hawara threw fresh light upon the whole question. The wax portraits discovered at Hawara originated in a custom which grew up in Egypt of having a hole cut in the upper part of the coffin and a portrait of the deceased inserted. The coffin was then stood up on end in a corner of the house, and ultimately removed for burial. Some of these wax portraits had been brought into the market by natives, but were regarded as probable forgeries until Flinders Petrie unearthed them *in situ*, many of them in an excellent state of preservation, and clearly revealing the use both of the cauterium and the brush. Petrie points out that the liquid condition of the wax after being laid on the panel is clearly shown in one portrait by the eye

DIRECT PHOTOGRAPH FROM ORIGINAL IN NATIONAL GALLERY
OF PORTRAIT FROM HAWARA (FLINDERS PETRIE)

having got smudged by a careless finger, just as to-day a still wet oil-painting might be injured. These portraits are of peculiar interest, as we see both processes described by Pliny used upon the same panel. The faces are usually modelled, while the drapery has been laid in with the brush; and, as Petrie points out, the difficulty of using wax in Egypt, at any rate for many months in the year, would not consist in the fact of its cooling too rapidly, but in the fact that it did not cool fast enough, as it would remain melted in the sun. In colder climates the difficulty can be got over by slightly warming the surface of the panel. The experiments which I myself made and which have been made by some Edinburgh artists have shown clearly that there is no real difficulty in carrying out this operation, even in a climate like ours. Each stroke of the brush must be laid on with certainty, and placed exactly where it is wanted, but there is no difficulty in keeping the panel sufficiently warm to make this possible without melting the whole of the wax already in position, as there is a considerable gap in temperature between that necessary to melt the wax and that necessary to enable the already melted wax on the brush to be laid into position. Both thin painting and impasto painting can be easily accomplished, and the finished work, after

polishing with a cloth, has all the appearance of an oil-picture.

A few more details of the process as carried out in my experiments may, however, be of value to any artist who wishes to experiment for himself.

In the first place, the white wax usually sold is commonly adulterated, and only genuine beeswax should be employed. This can be obtained through reputable druggists if the genuine article be demanded, and is somewhat yellow in colour. This amount of yellowness will not seriously affect the pigments.

A panel of wood well seasoned and without priming, or a panel coated with gesso, can be used. It is rather apt to warp a little during use, and on the whole the thin unprepared panels to be obtained from artist's colourmen are found most useful. If canvas is used it should only be sized and not primed. Probably unsized canvas would do equally well.

To prepare the colours, finely powdered dry pigments should be purchased and then melted up with wax in the little stamped metal pans which are used by microscopists to prepare their sections.

These pans are best kept hot on a copper plate some eighth of an inch thick and twelve inches each way, which is placed over a ring Bunsen burner turned low.

This copper plate also serves as a palette for mixing tints. Ordinary stiff artist's brushes are used, but care has to be taken to prevent the plate getting so hot that the brushes are burnt.

The panel can be warmed in front of a fire, or over a ring burner, simply waving it about in the hand; or a soldering bolt can be used held near the surface, though this is not recommended. Practice is of course required so as not to overheat or underheat the panel, and to put in the touches of pigment firmly and quickly while the wax is still hot. Mistakes can be removed with a penknife, and the picture when finished can be polished by lightly rubbing with a handkerchief.

The moulding with the cauterium has also been thoroughly cleared up by the discovery of the actual instruments in Pompeii and elsewhere. The most interesting of all these discoveries was a painter's grave found at St Médard in France, evidently of about the fourth or fifth century. The artist was a lady, and she had had her grave made sufficiently large to contain not only her own body, but all her implements of painting. The remains of brushes, and a series of bronze instruments were found, long and thin, flattened at one end and shaped like a spoon at the other, which were the cauteria used for

melting and also for modelling the wax. In addition to the pots of paint, the grave also contained jars of beeswax and mixtures of beeswax and resin. The reason for the presence of resin is fairly obvious. As has been already explained in referring to the Egyptian coffins, the simplest form of varnish which could be used is the natural semi-fluid resin as it comes from the tree. Such semi-fluid resins, obtained from the pine, are well known, as Venice turpentine and the modern Canada balsam, and would exist in large quantities in the neighbourhood of the artist of St Médard. Working in a colder climate than the artist of Egypt or Greece, it would be of advantage to reduce the melting-point of the wax, while anything which increased its transparency and the hardness and durability of the finished picture would also be a gain. All these objects can be easily accomplished by mixing the balsam to be obtained from the neighbouring pine-woods with the beeswax, thus forming a medium more suited to northern climates than the original beeswax of the Greeks.

There was also found in the grave at St Médard a bronze box covered with a silver grid, which probably contained glowing charcoal and could be used for melting the wax and warming the panel if necessary.

PAINTING IN MELTED WAX

By ADAM THOMSON

According to receipt in Pliny.

Page 50.

The following quotations from Pliny will serve to make the descriptions given above of the method of encaustic painting perfectly clear. In the first place, in chapter xlix. of book xxi. he describes the preparation of beeswax as follows :—

" Wax is made from honeycombs out of which the honey has been pressed. Having been first cleaned with water and dried for three days in the shade, the combs are on the fourth day melted on the fire in a new earthen vessel with water enough to cover them, and then strained off in a wicker basket. The wax is again boiled in the same pot with the same water, and is poured into cold water contained in vessels the interior of which has been smeared all over with honey. The best wax is that called Punic, the next that of a very yellow colour with the smell of honey, which, though of Pontic origin, is unaffected, I am surprised to find, by its poisonous honey. Next best is the Cretan, for it has a large proportion of propolis of which we spoke when treating of bees. Next to these is the Corsican, which, as it comes from the box-tree, is believed to have medicinal qualities. Punic wax is prepared as follows : Yellow wax is exposed to the outside air for some time, then boiled in sea-water taken from the open sea, with nitrum added. Then the flower, that is, the whitest part, is

skimmed off and poured into a vessel containing a little cold water. Again it is boiled in sea-water by itself, then the vessel, or at least the water, cooled. When this has been done three times the wax is dried in the open air on a mat of rushes in the light of the sun and the moon. For the latter makes it white, the sun dries it, and lest it should melt it is covered with a thin linen cloth. It will become exceedingly white if it is boiled again after the exposure to the sun. Punic wax is the most useful for medicines. Wax becomes black when papyrus ash is added to it. It becomes red when mixed with alkanet; with pigments it is made to assume various colours in order to represent true likenesses of objects. It is useful to men in numberless ways, even serving as a protection for walls and weapons. Other particulars concerning bees and honey we have stated when speaking of the nature of these insects."

This chapter has given rise to extraordinary misconceptions and speculations, under the idea that "Punic wax" was a mysterious substance of the nature of a wax soap or emulsion.

It has been conclusively proved by modern chemical investigation, in spite of a recent revival of these theories by Herr Berger in his *Maltechnik des Alter-*

tums, that "Punic wax" differs in no respect from ordinary wax, the boiling with "nitrum" or bicarbonate of soda and salt water being without influence on the final product, while the preparation of an emulsion of wax and soda is clearly ruled out by Pliny's own description of its preparation and properties.

In the part of his work devoted to painting the following references occur to the encaustic process, which will be sufficiently clear after the description already given.

In the first place, in the table of contents we find the following :—

"Qui penicillo pinxerint.
De avium cantu compescendo.
Qui encausto cauterio vel cestro vel penicillo pinxerint."

"Those who painted with the brush.
On silencing the singing of birds.
Those who painted in encaustic with the cauterium, the cestrum, and the brush."

This table of contents is one of the pieces of evidence among others of the existence of two kinds of painting—one with the medium unknown and the other with wax, as we find in the context that at the end of the long description of painters who are

merely spoken of as "painters with the brush" comes a quaint chapter in which we are told how an artist silenced the singing of the birds by frightening them with the picture of a dragon painted round the walls of his garden; and then follow the chapters dealing with encaustic painters.

The next important reference occurs among the chapters describing the preparation and properties of various pigments, and is as follows, in chapter xxxi., book xxxv. :—

"Ex omnibus coloribus cretulam amant, udoque inlini recusant purpurissum, Indicum, cæruleum, Melinum, auripigmentum, Appianum, cerussa. Ceræ tinguntur isdem his coloribus ad eas picturas, quæ inuruntur, alieno parietibus genere, sed classibus familiari, jam vero et onerariis navibus, quoniam et pericula expingimus, ne quis miretur et rogos pingi, juvatque pugnaturos ad mortem aut certe cædem speciose vehi." "Of all colours those which love a chalk ground and refuse to be laid on a damp surface are purpurissum, indigo, cæruleum, Melian white, orpiment, Appianum, and white lead. Waxes are stained with these same colours for pictures in encaustic, a kind of painting unsuitable for walls, but commonly used for ships of war, and now also for merchant ships. Since we paint even those vehi-

cles of danger, no one should be surprised if we also paint our funeral piles, and like to have gladiators conveyed in splendid carriages to death or at least to carnage."

Again, after completing his description of artists who painted with the brush, he says, in chapter xxxix. of book xxxv. :—

"Ceris pingere ac picturam inurere quis primus excogitaverit, non constat. Quidam Aristidis inventum putant, postea consummatum a Praxitele; sed aliquanto vetustiores encaustæ picturæ exstitere, ut Polygnoti et Nicanoris, Mnesilai Pariorum. Elasippus quoque Aeginæ picturæ suæ inscripsit ἐνέκαεν, quod profecto non fecisset, nisi encaustica inventa." "It is not agreed who first thought of painting with wax colours and making a picture by heat. Some think the art was invented by Aristides and afterwards brought to perfection by Praxiteles. But there are in existence encaustic pictures of a date somewhat earlier than theirs, such as those by Polygnotus, and by the Parians Nicanor and Mnesilaus. Elasippus also wrote on his pictures at Ægina ἐνέκαεν, which he certainly would not have done unless encaustic painting had been invented."

As has been already stated, the inaccurate translation of the opening lines of this chapter has given

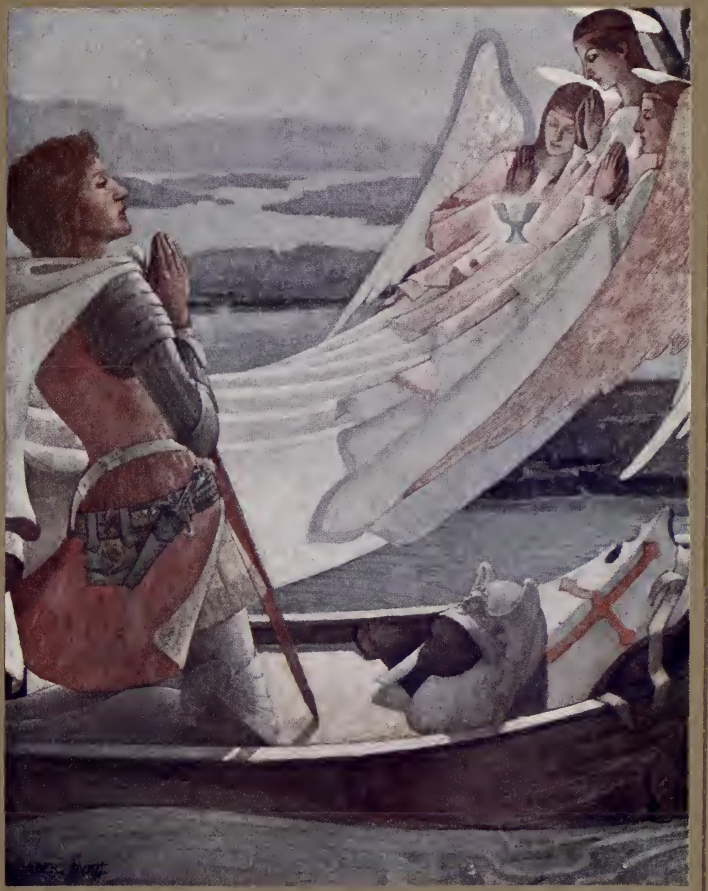
rise in the past to endless misconception of the real nature of this process.

In conclusion, in chapter xli. of book xxxv. is as follows :—

" Encausto pingendi duo fuere antiquitus genera, cera et in ebore cestro, id est, vericulo, donec classes pingi cœpere. Hoc tertium accessit resolutis igni ceris penicillo utendi, quæ pictura navibus nec sole nec sale ventisve corrumpitur." " In ancient times there were [only] two methods of encaustic painting, with wax and on ivory with the cestrum, that is, with a sharp-pointed tool, until it became the custom to paint ships of war. Then the third method was added, that of melting the wax colours with fire and laying them on with a brush. This kind of painting applied to ships is not injured by sun, wind, or salt water."

After the description which has already been given of this method of painting, no further discussion of the quotations is needed, as, with the exception of the reference to ivory and the cestrum, they are perfectly clear and consistent.

We have thus succeeded in piecing together a complete picture of this lost art of painting, which in skilful hands must have had great possibilities, and approached very nearly in its effects to those obtained to-day from solid painting in oil.



PICTURE PAINTED IN MELTED WAX

By ROBERT BURNS, A.R.S.A.

According to receipt in Pliny

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CHAPTER VI

CLASSICAL METHODS—THE OTHER MEDIUM PROBABLY USED BY CLASSICAL PAINTERS

Reference has already been made to the fact that there were two schools of Greek painters, one of whom used wax, in the ways already described, and the other school using some other medium. It is quite clear from Pliny's text that this other school existed, although it would take us too long here to give a complete proof of this by quotations from his *Natural History*. This other school were also painters on panel, although Pliny speaks as well of painting on canvas, and reference to wall-painting is made by him, although he makes no very clear distinction as to the methods used. According to him, they were all painters with the brush, without any further distinction. We have to look, therefore, for negative rather than positive evidence as to what this medium probably was. In the first place, the question natur-

ally arises as to whether they may not have painted in oil, and it has in fact been suggested by some writers that this was probably the medium used. Such painting in oil requires, of course, not only a knowledge of drying oils themselves, but also their properties—that is, of gradually absorbing oxygen from the air and forming a firm, transparent, elastic varnish. It is possible, of course, that anything may have been known in classical times, and that no record may have been kept of it; but in an inquiry of this kind we are bound to assume, until evidence has been overwhelmingly produced to the contrary, that the actual statement left us by writers like Vitruvius, himself a practical architect, and like Pliny, who collected all the knowledge of his time to pour into his *Natural History*, is in itself complete, and that, although details may be missing, yet the main facts known at the time are given to us. In the chapter on Egypt the two methods of preparing varnishes by mixing them with a volatile medium or mixing them with a drying oil were fully described, and it was pointed out that it was highly probable that the varnish used by the Egyptians was the natural varnish formed by the semi-liquid resin as it comes from the tree; but not very much was said about the drying oils themselves. There are several vegetal

oils that have this peculiar property of drying, but of these the best known are linseed oil, walnut oil, and poppy seed oil; and we find in Pliny's descriptions of oils of various kinds that he mentions the preparation of walnut oil, while again in Dioscorides we find a description of the preparation of poppy oil. Neither of these writers describes the preparation of an oil from linseed, although the linseed itself is described as suitable for making poultices for medical purposes. We have, then, a knowledge of the two oils, but there is no hint or suggestion throughout Pliny that these oils differ from any other oils in their property of drying, or that they can be utilised on that account as a medium for painting. The first suggestion of the use of a drying oil, not as a medium for painting, but as a varnish to cover the finished pictures, is made by a medical writer of the sixth century of the name of Aëtius. We are therefore bound to assume until further evidence is obtained that the use of drying oils for a painting medium had not occurred to the minds of anybody in classical times, the nearest approach to recognition of their properties being the description by Pliny of a bird-lime made of the juice of the mistletoe mixed with nut oil. Another strong argument against their having been known is the fact, already stated, that they

used wax as a medium for painting pictures. Wax in itself is so troublesome a medium to handle as compared with oil, that there can, I think, be no doubt that if they had known of the use of drying oils they would have discarded wax. On the other hand, as we have already seen, they were familiar with the preparation of glue, and in preparing lamp-black for the painter's use ground it up with a little glue according to the modern practice, and with the use of gum for preparing inks. Then they also had, of course, the tempera medium, egg, either the white or the yolk, at their command. We find in Pliny reference distinctly made to the use of egg. Curiously enough, an egg medium which we shall find described by Cennino Cennini in the fifteenth century as a mixture of egg with the juice of the fig tree (which contains a certain amount of caoutchouc), is mentioned by Pliny, but is not described as being used by the painter, but as being used for medical purposes. Pliny, however, in telling us how to lay on gold leaf, advises that it should be done by means of white of egg painted upon the properly prepared surface. In another place he tells us that in order to produce a purple colour the Tyrian purple mixed with egg is painted over sandyx. These are the only two references which he makes to the use of egg on the

part of painters, and it is not at all clear from the second reference whether he is referring to painting on panel or to painting on walls, and whether he regards the use of egg as peculiar or is merely describing the way in which the particular tint is produced upon the picture by the combination of these two colours. The actual passage, which has given rise to much comment, is as follows (chapter xxvi., book xxxv.): "Pingentes sandyce sublita, mox ex ovo inducentes purpurissum fulgorem minii faciunt. Si purpuræ facere malunt, cæruleum sublinunt, mox purpurissum ex ovo inducunt." "Painters put on sandyx as a ground colour; thereafter, laying on purpurissum with egg, they produce the brilliance of vermilion. If they prefer to produce the brilliance of purple they put on cæruleum as the ground colour, and then lay on purpurissum with egg." Again, it is obvious from his accounts of the pictures painted by this method that they were easily injured by damp; and he tells a story of Protogenes attempting to paint the foam upon a dog's mouth, repeatedly painting it in and sponging it off again, until at last in a temper he threw the sponge, loaded with pigment, at the picture, and found that he had produced exactly the effect he wanted. This certainly suggests the use of some medium mixed with water, although the

description is not incompatible with the use of an oil medium. There is also a reference made by Plutarch which in the absence of more direct evidence may perhaps be taken as throwing some light upon the question, although its application to this purpose has been criticised by some good scholars. In his *Amatorius* he says: "For indeed sight seems to paint all flying fancies on a wet ground, so swiftly do they fade and leave the mind; but the images of those beloved, painted by it as it were in encaustic by means of fire, leave behind in the memory shapes which move and live and speak and remain for ever."

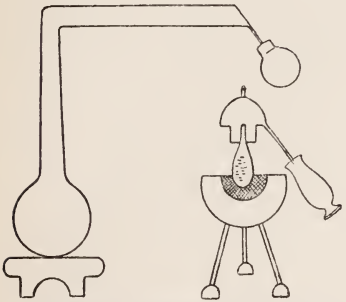
He certainly seems to be contrasting here the two schools of painting, the painters in encaustic or wax and the painters on the wet ground, so that, if this passage is to be taken literally, the other school of painting made use of some watery medium. The first actual reference to a painting receipt is not made until we come to the third or fourth century, when in a papyrus found at Thebes a medium consisting of egg and gum mixed, with the addition of bile to make the colour flow easily, is referred to. This is the whole of the evidence available as to the medium which was used in classical times; but we must remember that we have in addition the fact of the Byzantine tradition, which was handed on

to the Italian artists of the fourteenth century, and in which we find that the medium is universally egg. There is also the fact that, of the obvious mediums at the command of the painter, gum, egg, and size or glue, egg would probably prove to be the most useful in classical times as it proved to be in medieval times; and therefore, until there is more definite evidence than is at present obtainable, we are probably fairly safe in assuming that the Greek pictures were painted with an egg medium just as the medieval and fifteenth-century pictures were painted in the same medium. The reason why Pliny never mentions the medium is that it does not occur to him to refer to something so obvious, and which is a matter of common experience and practice. He speaks of the invention of the wax medium, and discusses who invented it. The other medium did not require invention, as it lay to everybody's hand. I have purposely avoided, in all this, again discussing the many fancy mediums which have been invented for the painters of classical times: the mixtures of wax and turpentine or naphtha, wax and drying oils, or wax and soda or potash. We shall have to discuss later certain receipts in which wax appears; but on the one hand the evidence from Pliny as to the actual process of painting from beeswax is so clear and

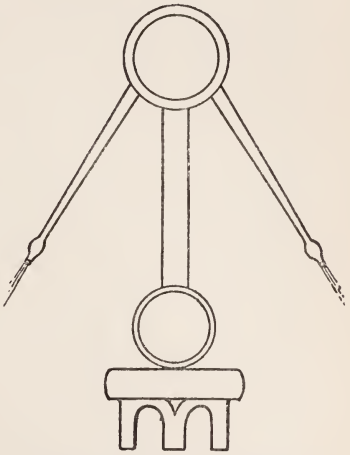
definite and proves to be so simple in practice, and on the other hand the evidence as to the second medium is so completely absent, that all such speculations are of no value to the student.

It still remains for us to consider the question as to how far the Greek pictures were varnished. The need of varnishes has already been dealt with, but it is necessary, perhaps, to say here a word or two more on the subject of the preparation of volatile mediums—namely, alcohol, turpentine, and naphtha, —as, unless we are quite clear as to the question as to whether volatile mediums existed in classical times, we cannot have a definite idea as to whether such mediums as varnishes are available. The preparation of these three mediums depends upon the knowledge of the art of distillation; that is to say, it depends upon the construction of a closed vessel with a pipe leading out from the top which is bent over and perhaps twisted into a worm, and in many cases placed in water to keep it cool. On boiling the liquid enclosed in the vessel the vapour passes through the pipe and is condensed and drips as liquid through the end. If, then, we wish to prepare alcohol from wine or beer or any other fermented liquor, we place it in a still and distil off the alcohol. In this way brandy, whisky, spirits of wine, and other more or

less impure preparations of alcohol are made. If we wish to prepare spirits of turpentine, the semi-liquid resin from the tree is placed in the still and the turpentine is distilled from it with the help of steam; or if from the crude petroleum as it rises from



The MSS. containing these figures of distilling apparatus (alembic) were copied in the eleventh and fifteenth centuries, but they reproduce more ancient MSS., and the figures correspond exactly to descriptions in the text.



Early distilling apparatus (alembic) from a MS. in St Mark's, Venice.

the soil we wish to obtain the thin, light, and volatile petroleum suitable for artists' purposes, we heat the petroleum in a still and use the portion which first comes over. It is evident, then, that a proper knowledge of distillation is necessary for the preparation of such volatile mediums, and therefore for

the preparation of what we have already described as spirit varnishes. The whole of this question has been investigated most carefully by Berthelot in his inquiry into early preparation of alcohol and into the history of early chemistry and of alchemy; and it is to some of the writers on alchemy that we have to look for information upon this subject. It is evident that the first form of still consisted merely of covering the open pot or vessel with some kind of cloth in which the liquid was condensed, and from which it could be wrung out afterwards. Pliny describes an oil which can be obtained from pitch by heating the pitch and covering the pot with a sheep's fleece, and then wringing out the fleece and collecting the oil. This is evidently a very crude method of distillation, which must have come before the invention of the proper still, which has already been described; and it is certainly unlikely that a satisfactory preparation of turpentine, naphtha, or alcohol could be made in this way or prepared of such a quality or in such quantities as would be of any use to the artist. It is not until we come at any rate to the third century that we get a definite description of the process of distillation; and while the early drawings have been lost, drawings have been found in a manuscript which is in the library of St Mark's

at Venice which agree closely with the descriptions given by these earlier writers. These drawings are of proper stills, though somewhat quaint in design; and the process of distillation was evidently clearly described by a learned Egyptian lady of the name of Cleopatra who lived some time in the early Christian era; while there are other references at about this time. We may take it, then, that the art of distillation was invented somewhere about the third or fourth century, but it was probably kept as a mystery among the alchemists and only used for the preparation of small quantities of distilled liquors for medical purposes; in fact, it is evident that such distilled liquors were regarded with much reverence and mystery. It would be long before such apparatus came into general use for supplying the needs of commerce or volatile mediums. Naphtha in its crude form was of course known to the ancients, as well as various forms of bitumen; and Pliny describes a kind of brine which was obtained by those living in Babylon, and from which by boiling an oil was separated which they burned in lamps. Pliny has other references to naphtha which need not be given here. It is of interest to notice that on the shores of the Red Sea there are known to-day to be certain shallow petroleum deposits mixed with brine.

If, then, we have no right to assume the preparation of volatile mediums, we are driven to the conclusion that any varnish used consisted of the natural varnish as it came from the tree or the resin mixed with drying oil. The mixture of resins and olive oil for medical purposes is found referred to by Pliny, but in no case is this admixture of drying oil referred to, or any suggestion made that in this way a varnish could be prepared. On the contrary, as already stated, the only approach towards a varnish of this description is a mixture of pitch and beeswax used for ships. Here again the use of oil would have yielded such a superior produce that the fact of beeswax being used is further proof that the properties of drying oils were not known. The classical painters then had the means to varnish their pictures with the natural semi-liquid resin or varnish obtained from the tree, and such semi-liquid resins were obtained at the time of the Roman empire from many sources. Pliny describes the resins from many varieties of pine, and also resins obtained from Syria and Africa, such as mastic, terebinth, and so on. We should therefore expect to find that the Greek artists varnished their tempera pictures. The one reference, however, to this process made by Pliny is very difficult to understand. Speaking of Apelles,

in the first place he begins by telling us of his inventions in the art of painting, but that one of them nobody has been able to imitate, and then he proceeds to give us a description of a process which is evidently some kind of varnishing. He tells us that he used to cover his pictures with a layer of 'atramentum,' so thin that, while it created a reflection of all the colours and protected them from dust and dirt, it was itself invisible until examined very closely. Pliny, in his description of atramentum, mentions among the varieties a kind that exudes from the earth like the brine of salt-pits. This could only be some liquid form of bitumen, and his description of the process used by Apelles might certainly be satisfied by his having very thinly covered his picture with a layer of liquid bitumen, because he tells us that one of the objects was to prevent the brightness of the colours from offending the eye. The bitumen, however, was, as obtained in its native state, probably too dark, and it is more likely that Apelles made use of a semi-liquid resin which he darkened by dissolving in it a little of the fluid bitumen, and then laid it over the picture. If the picture was painted in tempera the effect of any such varnishing process would be very much as Pliny describes. The real difficulty lies in the fact that Pliny says nobody

has been able to imitate this effect. At a time when pitch and crude varnish were being used constantly on ships, and long after the time when the Egyptians had been accustomed to varnish their coffins, and with semi-liquid varnishes capable of being obtained from various sources, it is very difficult to understand how this process of Apelles could have involved any mystery whatsoever. It seems incredible that the Greek painters had not realised the advantages to be gained by varnishing their tempera pictures, and were not accustomed to do so; and it seems more probable that Pliny, ignorant of the knowledge of the studios, was under a complete delusion when he imagined that Apelles had been able to make use of a process which was not known to the other painters. On the other hand, we are certainly not justified, as has been done by many writers, in assuming a common knowledge of the advantages of varnishing pictures on the part of the painters of classical times, an assumption based upon this quotation from Pliny, for Pliny begins by telling us most distinctly that this process of Apelles is one that nobody had been able to imitate.

These remarks of Pliny's are so interesting that they may well be quoted in full: "Inventa ejus et ceteris profuere in arte; unum imitari nemo potuit, quod

absoluta opera atramento inlinebat ita tenui, ut id ipsum, cum repercussum claritatis colorum omnium excitaret, custodiretque a pulvere et sordibus, ad manum intuenti demum appareret, sed et *lum*inum ratione magna, ne claritas colorum aciem offenderet veluti per lapidem specularem intuentibus et e longinquo eadem res nimis floridis coloribus austeritatem occulte daret." "His innovations in the art of painting have also been useful to others; but one of them nobody has been able to imitate. He used to cover his pictures after their completion with a layer of atramentum so thin, that while it created a reflection of the brightness of all the colours and protected them from dust and dirt, it was itself visible only to one examining very closely. But the chief purpose was to prevent the brightness of the colours from offending the eye (they were as if looked at through talc), also that when seen from a distance the too florid colours might be imperceptibly chastened."

As the result, then, of our inquiry into classical methods of painting on panel, we have been driven to the conclusion that there were two recognised methods of painting; that of these one was with a medium not described, but which in all probability was the egg medium used by the Byzantine and by

the Italian artists of later times, but whether these tempera pictures were varnished or not must be left an open question, though there is no reason why they should not have been so treated. The second method of painting by means of beeswax we have already fully described.

CHAPTER VII

CLASSICAL METHODS—WALL-PAINTING

The methods employed in painting pictures upon walls during classical times have led to a great deal of controversy, and in spite of the many theories which have been advanced there are many questions which are not yet clearly settled. It is obvious from what has already been said that several methods of painting on walls might have been made use of by the ancients. In the first place, to deal with the dry plastered wall surface, pigments might be laid upon it with any of the mediums already discussed. Egg, gum, or glue could well have been used. And we have already seen that the wall-painting in Egypt was of this character, glue or gum being the medium which apparently was usually used there for painting on walls. In addition to this it might be possible to make use of wax, although the description of the wax process already given is suffi-

cient to reveal the difficulties of utilising it for such a purpose. If we suppose the wall surface to be sufficiently warm from climatic conditions, there would be no difficulty in painting on such a wall with melted wax; but where the surface of the wall had to be heated, the difficulties would be very great. As we shall find, both Pliny and Vitruvius describe such a heating process where walls in certain cases had to be varnished with wax, and therefore it is quite possible that similar methods might be used for painting purposes. It is worthy of experiment how far in the summer the walls of Greek temples are sufficiently warm to enable painting with melted wax to be carried out. With reference to the evidence as to the use of wax in wall-painting, it is of a somewhat contradictory character. In the first place, Pliny states quite definitely that wax was not suitable for painting on walls, and yet he himself tells us that Agrippa had the potters' work in the baths painted in encaustic. This seems to have been ornamental terra-cotta work, and it is possible that the encaustic painting was done upon the terra-cotta before it was placed in position. We also have in the accounts of the building of the Erechtheion the entry of a sum paid to encaustic painters. That encaustic was used for ceiling decoration seems clear from the statement in

Procopius that Justinian, on restoring the imperial palace, had the ceilings decorated not with paintings in melted wax but with mosaic. If, then, by these statements is meant the encaustic painting which we have already discussed, it is evident that, in spite of Pliny's statement that it was not suitable for walls, it seems to have been at any rate sometimes applied to them. It is, however, just possible that by encaustic painting in this case was meant a slightly different process which presently we shall have to discuss. Besides the mediums already suggested—egg, glue, gum, and wax—for painting upon dry surfaces, there was another way in which the wall surfaces could be treated, and that was by the method which is now known as buon fresco, the pigments being merely mixed with water and laid on the wet plaster. This is the process which is usually called true fresco, and which was so largely used by the Italian painters for wall decoration in the sixteenth century. There are also possible modifications of this: the pigments, although laid on the wet plaster, might be mixed before being so laid on with a suitable medium, and this process might be combined with dry wall painting; in fact, we shall find that Cennino Cennini directs the painting of a wall to be finished by means of pigments mixed with egg, and it was only in the

later and stricter school of Italian fresco-painting that all additions of dry colour were objected to. Not only were all these different methods open to the painter, but it is quite obvious from the beginning that different methods were used. In the case of the Greek temples, the pigment was laid either directly upon the marble surface or more commonly upon the thin coating of plaster laid over the stone. Where the painting was done directly on the marble surface, or on the thin plaster, the process cannot have been that of buon fresco, which necessitates a surface of wet plaster which at any rate would remain damp long enough for the painting to be finished. It is not at all likely, therefore, that in the case of the Greek temples, where the climate is warm, that the very thin coat of plaster used would be sufficiently damp to be suitable for buon fresco; and it is also highly probable that, whatever the process used by the Greeks might be, it would be equally suitable for the plaster and for the marble surfaces. In addition to this, we know that the Greek marble statues were coloured, and no doubt the same process was applied in this case also. It was customary in the case of the Greeks to polish their marble statues with wax, this polishing process being known as "ganōsis"; and we shall have presently to refer

to this again. In the case of the frescoes at Knossos which have recently been discovered, Heaton, who has carefully examined them from a chemical point of view, has come to the conclusion, as I have already stated, that they are examples of buon fresco; and incidentally in this case we find that the masses of plaster are very thick, so that the keeping of a damp surface would not be so difficult. Coming next to the frescoes at Pompeii, and other frescoes of Roman origin, the painting in these cases has been done upon a very thick plaster ground, and on the whole the evidence of the experts is in favour of the conclusion that in these cases we are dealing with buon fresco. There are certain references in Pliny which indicate at any rate that he was quite aware of the painting done upon wet plaster; and in Vitruvius we have a long description of the method of preparing the plaster and painting upon the surface—a description from which, again, great controversy has arisen, for it is not clear whether it merely refers to the preparation of the colour surface upon which the picture was painted or to the actual picture itself, and this doubt is of great importance owing to the fact that in many of the Pompeian frescoes the whole of the plaster is covered with a uniform colour ground upon which the paintings are executed. The results

of analysis might be expected to throw light on the question, but these results are not altogether conclusive. In some cases no organic binding vehicle has been found; in other cases an organic binding vehicle has been proved to be present which, judging from the descriptions of the analyst, might either be egg or milk or glue. In the case of the Greek wall-paintings, the result of analysis has been to show an organic binding material and the presence of wax, but no wax has been found in the case of the Pompeian or other Roman frescoes. These results, then, are quite sufficient to confirm what has already been said: that it is quite evident that there was not one recognised method in classical times for painting wall surfaces, and that there was probably a sharp distinction to be drawn between the methods used in Greece and the methods used in Rome. This distinction may have been very largely due to climatic considerations, the cooler climate found in Italy being possibly more suitable for genuine or buon fresco.

We shall now proceed to consider in more detail the actual information given on this subject by Pliny and Vitruvius. This I can best do by selected quotations from my recent book *Greek and Roman Methods of Painting*, in which the whole subject is critically and fully discussed :—

"The principal authority whom we shall have to consult in this matter is Vitruvius, but before doing so we shall consider first the statements made by Pliny which throw light on the subject. We have already noted one of these, in which he says definitely that encaustic painting is not suitable for walls. In the opening of the same chapter, which I here requote, he mentions certain pigments as not suitable for painting on a wet surface.

"'Ex omnibus coloribus cretulam amant udoque inlini recusant purpurissum, Indicum, cæruleum, Melinum, auripigmentum, Appianum, cerussa.' This sentence is quite meaningless if it is intended to apply to water only, but if it means a wet surface of lime it becomes intelligible, as many of these pigments would be destroyed by wet lime. The reference to wall-painting in the next sentence makes this meaning all the more probable.

"But this chapter must be considered in conjunction with another chapter, xxxiii. 56, where he is describing different varieties of ochre. One variety he calls marmorosum sil, and then goes on to say: 'Hoc autem et Attico ad lumina utuntur, ad abacos non nisi marmoroso, quoniam marmor in eo resistit amaritudini calcis.' 'This and the Attic sort they use for high lights; for panelled spaces none but

the marmorean kind, because the marble in it resists acridity of the lime.'

"If this mention of a special ochre which resists lime be read along with the mention of the special colours which do not resist a wet surface, I think the combined evidence shows clearly that he is speaking in both cases of the action of wet lime, and therefore is familiar with the process of painting on wet plaster. There is, however, another interesting point to be noticed in the last quotation. One of the arguments against the use of buon fresco in classical times is the large area covered at one time by many of their wall-paintings, as it is held that buon fresco involves the treatment of limited areas at a time, and therefore joins should be visible. We shall have to consider these matters presently at greater length, but in this chapter Pliny distinctly suggests, by the use of the word *abacus*, that limited spaces or panels only are painted on the wet plaster, and that consequently a pigment which could resist wet lime was selected for the painting of such limited areas. It may well have been that, while this wet painting was used for important decorative pictures, the cheaper decorative colouring round the margins was painted on dry plaster in a less durable manner.[1]

"[1] Wiegmann holds this view: *Die Malerei der Alten.*"

We shall find some remarks of Vitruvius bearing on this point. In the meantime the evidence is clear and unmistakable from Pliny that he was familiar with the operation of painting on wet plaster. This does not, however, exclude the possibility of some medium like size being mixed with the pigments laid on this wet surface.

"We shall next consider the information to be obtained from Vitruvius.

"In the seventh book of his work on Architecture, after describing the making of concrete floors and the preparation of lime, and the plastering of arches and cornices, he proceeds as follows, in the middle of the third chapter :—

"'When the cornices are finished, the walls are to be trowelled as roughly as possible, and thereafter, when the trowelling is somewhat dry, over it the directions of the sand-mortar are to be so traced out, that in length it must be true by the rule, in height by the plumb-line, and the angles by the square. For thus the surface of the plaster will be faultless for pictures. When this (first coat) is slightly dry, a second is to be laid on, and then a third. The firmer and sounder the laying on of the sand-mortar, the more solid and durable will the plaster-work be. When besides the trowelling not less than three

coats of sand have been set out, applications of marble-dust[1] are to be used. This stuff is to be so tempered that in the spreading it does not stick to the trowel, but the iron comes out of the mortar clean. A coat of marble-dust[1] having been laid on and getting dry, another rather thin coat is to be applied. When this has been beaten and well rubbed, another still finer is to be put on. Thus with three coats of sand and as many of marble, the walls are so firm that they cannot crack or become defective in any way. And, moreover, solidity being secured by rubbing with planes, and smoothness from the hardness and sheen of the marble, the walls will give out with great brilliance colours applied with polishings. For colours, when they are carefully laid on damp plaster, do not get loose, but are for ever permanent, for this reason, that the lime, losing all its moisture in the kiln, is so dry and porous that it readily imbibes whatever chances to touch it, and solidification taking place from the mixtures of the various potentialities whose elements or first principles are brought together, the resulting substance, of whatever it is composed, when it becomes dry, is such that it seems to have special qualities peculiar to itself. Thus plaster-work which is well executed

"[1] *I.e.* marble-dust mortar."

neither becomes rough from age nor when it is washed does it give up the colours unless they have been laid on carelessly and on a dry surface. If, therefore, plaster-work on walls is carried out as above described, it will be firm, lustrous, and very durable. But when only one coat of sand and one of marble-dust are used, its thinness renders it liable to be easily broken, nor can it take on a proper brilliance from the polishings owing to its lack of substance. For just as a silver mirror when made from a thin plate gives back a wavering and uncertain image, but if made from a plate of solid temper takes on a high polish and reflects to the spectators bright and faultless images, so plastering, when its substance is thin, is not only full of cracks but also quickly decays, while that which is firmly compacted of sand-mortar and marble, when it has been rubbed with many polishings, is not only glistening but also clearly reflects to the spectators the images falling on it. Greek plasterers, indeed, use not only the above methods to make their work firm, but also putting the lime and sand together in a mortar, they have it thoroughly pounded with wooden staves by a number of men, and use it after it is so prepared. Hence from their old walls people cut out slabs and use them as panels, and those plaster slabs so cut

out for panels and mirrors have fillets in relief round them.'[1]

"We shall now consider the information to be derived from this passage.

"In the first place, the instructions for preparing the plaster surface are perfectly clear and definite.

"In the second place, whatever doubt there may be about the translation of line 3, line 4 can only be translated as meaning that the pigments are to be laid on the wet lime.

"In the passages after line 4 there is a most interesting attempt to explain the way in which the lime and pigments ultimately form a homogeneous whole. If, instead of speaking of the lime losing its moisture, Vitruvius had said losing its carbonic acid, the passage might with this emendation have been written by a modern chemist describing the scientific basis of buon fresco. I do not understand why this most interesting passage has been condemned as obscure.

"In the next place, it is to be noted that Vitruvius does not speak of this as the *only* method of wall-painting, but as the most *durable* method, and contrasts it with the results obtained by painting on a dry surface.

[1] Further information about ancient mortars will be found in *St. Sophia* by Lethaby and Swainson. London, 1894.

"We have here definite evidence that painting on dry walls was also customary, in which case some medium like glue would doubtless be used, and this goes a long way to explain the conflicting conclusions of investigators and chemists.

"Vitruvius in effect tells us that he is familiar with painting on dry walls, necessarily with some binding medium, and with painting on wet lime, and he regards the wet-lime painting as the more permanent. He would not have come to this conclusion without a wide experience of both methods.

"We have next to consider whether, in painting on wet plaster, any medium such as glue was introduced. No such medium is mentioned by Vitruvius, and we are therefore bound to conclude that it was absent, until chemical analysis or carefully conducted experiments prove the contrary. There is no necessity for its introduction in buon fresco. As I have already pointed out, no conclusive evidence is to be derived on this point from Pliny.

"I have already discussed the references in Pliny and Vitruvius to the mixing of glue with black, and have shown that they do not prove the use of glue as a medium, as they are capable of quite a different and equally plausible explanation.

"A further study of this chapter shows clearly that

this method of fresco-painting was very different from the method used in the time of the Renaissance, or to-day, as there are frequent references to the *polishing* of the surface during the process. Herr Berger was, I believe, the first to point out the significance of these polishing processes. In order to understand the meaning of these passages, we shall have to consider more clearly the nature of buon fresco itself.

"When the pigment is flooded over the wet surface of the plaster, the particles settle into the hollows of the surface, bathed in a solution of lime. As this solution of lime becomes carbonated and precipitated by the carbonic acid of the air, the particles of pigment are packed round with the precipitated carbonate, so that the holding of the pigment to the plaster is more of the nature of a mechanical than a chemical process.

"Moreover, lime is so slightly soluble in water, and the carbonating of the lime is so slow a process, that each time the surface is flooded with water, fresh unaltered lime is dissolved and brought to the surface of the plaster, for many days.

"There is no need, therefore, for the *immediate* painting of a surface as soon as the last layer of plaster is put on, though, on the other hand, it is as

well that the plaster should be kept damp, in order to keep a soft bed beneath the pigments, into which they can become more or less incorporated. If this is done there is no reason why a large surface should not receive its final coat of plaster and then be painted on in a leisurely manner, as long as, by means of damp cloths or occasional sprinkling over with water, it is prevented from getting too hard. The particular technique, therefore, adopted by the Renaissance painters, a small portion at a time receiving its final coat of plaster and then being painted on, is not of the essence of the buon fresco process.

"The Roman plaster was not only very thick [up to 5 inches], but the numerous coats were to be put on before the last coats were completely dry.

"Such a mass would hold the contained water for some time, and could easily be kept damp if necessary, while the painting could be proceeded with in a leisurely manner.

"It is next necessary to consider carefully the statements made in Vitruvius about polished surfaces. As he does not direct the addition of any foreign substances, we must first try whether such a polished surface can be produced by the methods he describes.

"In order to test this I had a series of shallow wooden trays made, into which I introduced first a

layer of lime and sand, and then laid on this, when partially dry, two layers of marble dust and lime, in the proportion of two of marble dust to one of lime.

"While the final coat was quite wet it was subjected to the process familiar to plasterers of 'closing in.' That is to say, it was worked repeatedly on the surface with the long, straight, slightly rounded steel edge of the plasterer's trowel, the trowel being held at an angle to the surface of about forty-five degrees. This closed-in surface, although inside a building, took several days to dry. As it got drier and firmer the working of the surface with the rounded edge of the trowel was repeated, by drawing it across with quick, firm strokes. Ultimately we obtained a dry, hard, compact surface with the appearance of polished marble. This satisfied me that, in so far as uniform plaster surfaces are concerned, the polished surface described by Vitruvius can be got without the introduction of any material beyond lime, marble dust, and water, although great technical skill is doubtless wanted, and great expenditure of time and patience, to produce a satisfactory result. It is, however, evident from his account that such polished plaster surfaces were highly prized, and were not the work of the everyday plasterer.

"The next experiments were made with pigments.

Microphotograph in three colours of portion of Roman fresco, showing Egyptian blue imbedded into lime and fragments of marble dust.

"I had had the opportunity of examining some portions of Roman fresco obtained some years ago by a friend from the Palatine. One of these was coated with vermilion,[1] another with red oxide of iron, and a third with the blue Egyptian frit. In the case of the vermilion, and to a great extent in the case of the oxide of iron, the coating of pigment appeared homogeneous under the microscope. But in the case of the coarse particles of the copper frit, which had to some extent weathered off, it was evident that the particles were imbedded in the plaster and flush with the particles of marble dust. In order to try to reproduce this appearance another panel of plaster was prepared and closed in. It was then allowed to dry for a day before being painted on, and then it was painted with a thin coat of cobalt blue in one part—laid on so as to show the brush-marks and different depths of work,—with a thick uniform coat of vermilion in another part, and with yellow ochre in a third part. It was then left for another twenty-four hours, and the whole surface then pressed firmly with the flat of the plasterer's trowel. This could be done without any disturbance

"[1] The plaster immediately below the vermilion was stained yellow, as if some wax and oil had been used. This appearance was absent in the other examples."

to the painted surface, but with an evident improvement in the vividness of the colouring. On examining under the microscope the whole surface appeared uniform and the pigments flush with the plaster, the edge of the vermilion and the edge of the plaster being in focus at the same time, and the particles of cobalt blue imbedded among and flush with the particles of marble-dust. (This pigment was selected because it is of a comparatively coarse grain, and corresponds most nearly therefore to the old Egyptian blue.) The surface was allowed to dry further, and then the attempt was made to polish it with the edge of the trowel. This was only partially successful; in some places a polish was obtained, in others the pigment was disturbed owing to a want of perfect smoothness in the edge of the trowel. Such a process of polishing does not seem, however, to be impossible, even in the case of a painted surface, if the right tools were devised and sufficient practice attained. But even the first stage of the process produces a smooth surface with some degree of shine about it, and compacts the whole mass together. When dry it can be washed with water or rubbed up with beeswax and turpentine.

"We shall next consider the special treatment to which the plaster surface was subjected in order to

protect vermilion, according to the statements of Pliny and Vitruvius.

"In the fortieth chapter of the thirty-third book, speaking of native vermilion, Pliny says: 'Inlito solis atque lunæ contactus inimicus. Remedium, ut parieti siccato cera Punica cum oleo liquefacta candens setis inducatur iterumque admotis gallæ carbonibus inuratur ad sudorem usque, postea candelis subigatur ac deinde linteis puris, sicut et marmora nitescunt.' 'When laid on, the exposure to sun and moon is harmful. The remedy is: when the wall is dry spread on it with a brush melted Punic wax mixed with oil and glowing hot, and again heat it to sweating point by placing charred gall-apples near it; afterwards rub it with candles, and then with clean linen cloths as marble is made to shine.' And Vitruvius, also speaking of vermilion, says in the ninth chapter of the seventh book: 'But in open places, that is, in peristyles and loggias and the like, into which sun and moon can dart their bright rays, the [painted] part when touched by these is marred, and the quality of its colour being destroyed it turns black. Thus it was that when Faberius the notary wished, like many others, to have his house on the Aventine hill richly decorated, he covered all the walls in the peristyles with vermilion. After a month they be-

came ugly and uneven, and accordingly he bargained with the contractors to lay on other colours instead of vermilion. But a more discerning person, who wishes his vermilion decoration to keep its colour, should, when the wall is well polished and dry, lay on with a stiff brush Pontic wax melted in the fire and tempered with a little oil; then bringing an iron pan of glowing coals near to the wall, he must heat both it and the wall and make the wax sweat, and thereafter, to make the surface even, he must rub it with a candle and clean linen cloths, as nude marble statues are treated. This process is called γάνωσις by the Greeks. The coat of Pontic wax being in front does not allow the play of the sun's rays or the sheen of the moon to take away the colour from such decorations.'

"In the first place, it is evident that this is a process for varnishing a surface already painted, and not for painting a surface. There is no inconsistency therefore, as some have held, in Pliny's saying in xxxv. 31, 'alieno parietibus genere,' where he is discussing the use of wax as a medium for painting, and on the other hand recommending it for varnishing an already painted surface. Mastic varnish, for instance, is quite suitable for varnishing pictures, but would make a very inconvenient and unsatis-

factory medium to paint with. In the second place, both Vitruvius and Pliny confine the use of this process to a special purpose, namely, the protection of vermilion, and only when exposed to direct sunlight. Vitruvius states definitely that it is not necessary where vermilion is used for interior decoration.

"This is a conclusive proof that this process was not a universal one. If the process had not been mentioned at all, it might have been omitted by accident and still have been used. But to mention a process and at the same time confine it to a particular purpose, shows quite clearly that it was not the general method of treating all wall surfaces. It will also be noted that Vitruvius says the varnish is to be applied 'cum paries expolitus et aridus,' clearly indicating that the decorative treatment with vermilion has been executed on the wet surface, which, after drying, is then varnished with wax.

"The use of the word *candela* has given rise to some difficulty. Some have suggested that it means that a lighted candle was used to warm the surface, others that a roller shaped like a candle is meant. Candles seem to have been known, made both of wax and tallow, and therefore others have said that the meaning is that the surface was finally rubbed

with a wax candle and a linen cloth. Another possible view is that a tallow candle was used for the final polishing.

"It will be noticed also, on examining the context, that it is not at all clear whether the statement about the polishing of marble applies to the whole process, or merely to the rubbing with candelæ and linen cloths. Either view would satisfy the translation.

" I tried the experiment of polishing marble with tallow, with wax melted with olive oil and then strongly heated after being applied, and with a lump of solid wax alone and a linen cloth.

" I failed to obtain a polish either by rubbing up with tallow or rubbing up after treatment with hot melted wax and oil. But I found that if the marble was very lightly rubbed over wtth a lump of solid beeswax, and then rubbed hard with a hard, rough linen cloth, a beautiful polish was at once obtained. The only precaution necessary is to avoid putting on too much wax when rubbing with the lump of beeswax. The layer is so thin that the marble is not in the slightest discoloured, but gets at once a glossy surface, which gives it depth and translucency. The marble used had already, of course, been smoothed and polished as far as was possible by merely treating the surface of the stone itself.

"A piece of wax, already shaped as a candle, would be very convenient for this purpose, being readily held in the hand while the end would be rubbed over the marble.

"The rubbing with wax candles is thus completely explained, and it is evident that while in the case of a porous plaster surface it is necessary to fill up the pores with hot wax to begin with, before polishing with wax candles and linen, in the case of marble this process is not necessary, the process called γάνωσις being the rubbing with wax candles and linen alone.[1]

"In conclusion, vermilion, when exposed to direct sunlight, does change colour in the way described, and is to some extent protected by being covered with a glossy surface either by varnishing or in the way described by Vitruvius.[2]"

While these experiments were being made there was a paper published by F. Gerlich in the *Neue Jahrbücher für das klassische Altertum*, 1908, de-

[1] "Pliny uses the word 'nitescunt,' therefore the process must give a shine. No doubt armour, to which he refers, would be polished the same way."

"[2] ἡ δὲ γάνωσις τοῦ ἀγάλματος ἀναγκαία· ταχὺ γὰρ ἐξανθεῖ τὸ μίλτινον ᾧ τὰ παλαιὰ τῶν ἀγαλμάτων ἔχρωζον. 'The "Ganosis" of the statue is necessary, for the vermilion with which the ancient statues are painted soon loses its colour.'—Plutarch, *Quæst. Rom.*, 287 D."

scribing the various experiments that have been made in Germany and fresh evidence collected, which on the whole confirms the conclusions to which I have here come. Recent analysis has confirmed the earlier chemists in their view that the Pompeian frescoes are free from organic material and are therefore examples of the buon fresco; on the other hand, it seems evident that the actual paintings themselves stand out a little from the smooth surface of the plaster behind, and therefore the polishing process which I have dealt with in some detail cannot have been applied to the painted surface itself, but must have rather been applied to the plaster after coating it with colour upon which the painting was to be carried out. It is difficult to understand why, if this was so, the frescoes have proved so durable; and even if a little lime may have been mixed with the pigments, as has been suggested, it is difficult to believe that this would really make a durable painting, so that there still seems to be some doubt as to the exact process practised by the Pompeian painters. The outcome of the inquiry, however, is not without its practical value, as in the first place it reveals the importance of marble-dust mixed with lime for forming a plastering surface. The beauty of the surface is very remarkable, the plaster not having

the dull appearance which one notices with ordinary lime plaster, or with plaster of Paris, but throwing off light, so that even when unpolished it has a certain brilliancy. The pigments laid upon it are peculiarly beautiful, and are thrown up by the rich creamy-white ground, while in the case of smooth surfaces the polishing can be brought up to the point of ordinary marble, and in the case of painted surfaces the method described, of pressing upon the surface with flat steel trowels, both enhances the brilliancy of the pictures and the bedding of the colour produces a smooth surface which should be remarkably durable and able to resist the attacks of time. Whether, therefore, the polishing of the surface by the process described by Vitruvius was carried out on the actual painted surface or not, there can be no doubt that we have here an actual technical process which might quite well be used by our modern fresco-painters. If the directions of Vitruvius are carefully carried out, and the plaster carefully prepared to the proper thickness, there can be no difficulty in producing the desired effect after the surface has been properly closed by repeated working with the trowel in the method already described. The finished painting then merely requires to be pressed so as to bring the whole surface firmly toge-

ther, and there can be no doubt that with a little practice a certain amount even of polishing can be done. While such a process of wall-painting is quite unsuitable in a climate such as that existing in Great Britain, and even more unsuitable in our modern cities in this country because of the smoke and dirt, it might well be revived in other countries where the smoke is absent and in which the dampness of climate is not so great.

With reference to the Greek method of painting on walls and statues, further experiments I have made have shown that beautiful effects can be obtained by painting on marble with size and then polishing with wax in the way already described, showing that we have here a method worthy of further investigation, and it seems at any rate quite possible that the encaustic painters were entrusted with this painting with size and polishing with wax, and that therefore the references to encaustic painting which have already been quoted do not mean that melted wax was the medium used. A large field is therefore opened up by these inquiries and experiments for further experiment which might result in adding some valuable technical processes which might be utilised by our modern artists. In such countries as America, for instance, with a clear

dry climate and smokeless cities, the use of marble and of marble-dust plaster and the painting of such surfaces might well be developed. Marble-dust plaster highly polished has, I believe, been already used in America, and the artist will find it a most beautiful surface on which to execute paintings.

CHAPTER VIII

THE FURTHER HISTORY OF FRESCO-PAINTING

It is evident from the foregoing account of classical methods that while there can be no doubt as to the preparation of the wall surface and the laying on of the ground coat of colour, there is some doubt as to the actual method of painting on this ground, the appearance of the Pompeian paintings apparently showing that the painting was done on this smoothed surface and is slightly raised. If this is always the case, the polishing process must have been confined to the preparation of the ground, and the attachment of the colour laid on by the artist must have been due to the lime water dissolved from the still wet surface, unless lime was added to the pigments.

In the case of frescoes found at St Médard, and probably fourth or fifth century, Chevreul found that he could split off one layer of colour from another

below, and that they all contained chalk. He therefore suggests that they were mixed with lime.

Presently we shall have to consider in this connection the instructions given by Cennino Cennini and by Theophilus, but in the meantime will continue to follow up in order the various pieces of information extant. In the Cathedral library at Lucca there exists a very old MS. of receipts of various kinds to which we shall have to refer more than once, and which is supposed to belong to the eighth century. In this the following statement is made: "Ita memoramus omnium operationes quæ in parietibus simplice in ligno cere commixtis coloribus in pellibus ictiocollon commixtum." "Thus we mention operations with all of them on walls unmixed, on wood the colours being mixed with wax, on skins fish-glue being mixed." This sentence tells us most clearly what the mediums used in painting at this time were. The pigments were laid doubtless on the wet plaster with no immixture (except water); wax was still used for panel pictures; and fish-glue (the preparation of which is described by Pliny) for illuminating on parchment. But it is elsewhere that we obtain probably the most authentic record of old-world methods and open up the most romantic incident in the history of the inquiry into ancient methods of painting. I refer

to the visit of Monsieur Didron to a monastery on Mount Athos, from which he carried away a treatise on painting and had also the opportunity of seeing fresco-painting done by the monks. This MS. is supposed to be of the fifteenth century, and claims to be the teaching of a painter of the eleventh century, and therefore might well be held to be of too late a date to throw fresh light on classical or post-classical methods. But when the isolation of the monasteries is considered we have at any rate a reasonable presumption that traditions would long remain unaltered. While, therefore, we are not justified in assuming that a method or medium not mentioned in classical times, but described in the Mount Athos manuscript, was known in classical times, yet we may regard processes which still seem the same as throwing light on older methods. Didron found the monks painting on walls exactly according to the directions given in this manuscript, usually referred to as the *Hermeneia*, from its Greek title, and the following is his description of what he saw. In the first place, two layers of lime plaster were laid upon the walls, each about half a centimetre in thickness. The first layer of plaster consisted of lime and chopped straw, and the second layer consisted of lime mixed with tow or flax or cotton, in this respect the practice evidently

being somewhat in agreement with the method of plastering adopted in the palace of Knossos, where, as we have seen, the plaster consisted apparently of lime with no addition either of sand or marble-dust. This plaster, after being finished, was allowed to dry for three days before the painting was begun. The drawings were then laid out by means of a compass with a brush attached to one arm, and the painting begun right away, simple washes of colour being laid on, followed by the necessary tints required for shading. It is unnecessary here to describe the somewhat mechanical method by which the shading and tints of flesh and drapery were built up. These details are fully given by Didron, and are also to be found elsewhere. The interesting fact to be noted is that no medium but water was used, that the painting did not begin until the plaster had been drying for three days, and it took some five days to complete, so that during this time the fixing of the pigments depended upon the dissolving out of fresh lime from the surface of the plaster, which would have already been considered too dry for painting on according to the practice of the sixteenth century and of to-day. This is entirely in agreement both with the description given in the *Hermeneia*, the manuscript of painting which Didron brought away from the monastery, and

also with what I have already said as to the false impression held by artists as to the rapidity with which lime becomes converted into carbonate of lime or chalk. There can be no reason why fresh lime water should not be dissolved out of the surface for days or weeks after the lime has been attached to the wall. At the same time, it will be noticed in the *Hermeneia* receipt that they distinctly direct that the painting is to be begun before a crust has formed upon the surface of the lime. Mr Traquair, who has had the opportunity of examining many Byzantine frescoes in the East, and who has kindly lent me photographs of such frescoes of the thirteenth century, and of later dates, tells me that he has found in many cases that a fresh fresco has been painted over the old one, a thin coat of fresh mortar about one-eighth of an inch thick having been laid over the surface before a new picture is attached. There seems to be no reason why in this case also there should not be sufficient lime dissolved to bind the pigment to the wall. Where the actual surface of the pigment is raised, obviously, above the surface of the wall, it is quite possible that a little lime has been added to the pigments in order to form the binding medium, and Theophilus, in his description of fresco-painting, distinctly advises that this

should be done. It also agrees with the description given by Chevreul of the frescoes at St Médard, though it may be noted that in the *Hermeneia* the use of chalk for mixing with the pigment is advised, but directions are most clearly given for avoiding the introduction of lime. It is significant of the Herculaneum frescoes that it is stated by Winckelmann that on trying to wash some of the frescoes the painting was at once removed, leaving the polished underground of colour untouched. The polishing of the ground, whether coloured or not, is also advised in the *Hermeneia* receipt, and Didron states that this was done before the painting was begun on the plaster surface. It is evident that such a closing in of the surface as we have already explained would tend to keep in moisture longer and prevent the rapid evaporation of the water. If, then, we are to take this Byzantine tradition as of any value in connection with the classical method, there can be very little doubt that the process was carried on as described by Vitruvius: that is to say, that the closing in and the polishing of the surface was a necessary stage; that if the whole surface was to be made of a uniform colour, it was at this stage that colour was laid on the wet plaster, and then polished; that upon this still damp and smooth surface the paint-

ing was carried out either with water or with the admixture of a little lime in the pigments; and that, just as at Mount Athos, the painting was carried out in a leisurely manner, there being no necessity for haste with a thick mass of damp plaster lying behind.

The most important references to wall-painting which we next have to consider are the directions given in the MS. by Theophilus, supposed to be written about the eleventh or twelfth century. We shall have to consider this MS. presently at much greater length, but in the meantime quote his instructions about painting on walls. In chap. xv. of the first book he directs as follows :—

"But on a wall, fill in a drapery with ochre, a little lime being added to it on account of the brilliancy, and make its shadows either with red simply, or with prasinus, or from posc, which is made from the same ochre and green. Flesh-colour upon a wall is made from ochre and cinnabar and lime, and its posc and rose colour and light are made as before. When figures or likeness of other things are portrayed on a dry wall, it is first sprinkled with water until it is completely soaked. And in this humidity all colours which are superposed are painted, all which are mixed with lime, and let them dry with the wall itself, that they may adhere. A colour is laid as a

ground under lazur and green which is called veneda, mixed from black and lime, upon which, when dry, lazur is laid in its place thinly, tempered with yolk of egg abundantly tempered with water, and over this again more thickly because of its beauty. Green also is mixed with succus and black."

It is evident from this account that Theophilus intends painting on the wall already dry, and advises, contrary to the Mount Athos practice, mixing lime with the colours. Probably a wise direction for an old dry wall. His reference to the use of egg for green and blue is very like the reference to egg medium already quoted from Pliny.

The next author that we have to consider is Cennino Cennini, an Italian painter, who wrote a treatise on painting early in the 15th century. I shall have to refer to this much more fully later on, but in the meantime shall merely consider his advice about painting in fresco (chap. lxvii.):—

"CHAPTER LXVII

"*The manner of painting on walls, that is, in fresco, and of colouring or painting the flesh of the faces of young persons.*

"In the name of the most holy Trinity, I will now put you to colouring. I begin first with painting on

walls, and shall teach you step by step the manner in which you ought to proceed. When you are going to paint on walls, which is the most delightful and charming kind of work that there can be, procure, in the first place, lime and sand, both of them well sifted. If the lime is very rich and fresh, it will require two parts of sand, the third of lime. [According to later authorities the lime should have been slaked for a year and the proportions of lime and sand half and half.] Grind them well together with water, and grind enough to last you fifteen or twenty days. Let it rest for some days till it be quite slaked; for if any heat remains in it, it cracks the plaster [*intonaco*]. When you are going to plaster, first sweep the wall, and wet it well—you cannot wet it too much; and take the well-stirred lime, a trowelful at a time, and spread it over once or twice, till the intonaco becomes quite even on the wall. Afterwards, when you are going to work, remember to make the surface of the mortar quite rough [*bene arricciato*] with a good tooth [*rasposo*]. Then, according to the subject or figures you have to make, if the intonaco is dry, take some charcoal, and design and compose, and take every measurement carefully, first striking one line, taking the centre of the space, and another for the horizon.

The perpendicular line by means of which the horizontal one is obtained must be made with a plumb-line. Then put one foot of the large compasses on the top of this line. Turn the compasses half round on the under side ; then put the leg of the compasses on the point of intersection of these two lines and make the other half circle above, and you will always find a cross on your right hand by the lines intersecting each other. Do the same on the left hand, which will give you two crosses, and the line between will be exactly level. Then draw with charcoal, as I have before directed you, historical pieces and figures, and arrange your spaces always equal. Next take a small and pointed bristle brush, with a little ochre without tempera, as liquid as water, and continue to draw your figures, shading them as you did with water-colours when I taught you to draw. Afterwards take a bunch of feathers and thoroughly brush away the charcoal.

" Then take a little sinopia without tempera, and with a finely pointed brush mark out the nose, eyes, hair, and all the extremities and outlines of the figures, and let these figures be correctly set out in every measurement which helps you to realise and project the figures which you have to paint. Then make your fringes [or ornaments, *fregi*] and acces-

sories as you please. Take some of the above-mentioned lime; stir it well with a trowel till it is like the consistence of ointment. Then consider how much you can paint in a day; for whatever you cover with the plaster you must finish the same day. Sometimes in winter, in damp weather, working on a stone wall, the plaster remains fresh till the next day; but if you can help it do not delay, because when painting in fresco, that which is finished in one day is the firmest and best, and is the most beautiful work. Then spread over a coat of thin intonaco, and not too much, first wetting the old intonaco. Next take your large hog's-hair brush in your hand, steep it in clean water, beat it and wet your plaster with it, and then with a slip of wood as wide as the palm of your hand rub round and round and over the wetted intonaco so as to remove the lime where you have put too much, and put more where there is not enough, and thus make your plaster quite smooth. Then wet the plaster with the same brush if necessary, and with the point of the trowel, which must be very clean and smooth, rub all over the intonaco. Then place your plumb-line as usual, and measure as you did on the underlying intonaco. Let us suppose that you can paint in one day the head only of a young male or female saint, such as

that of our most holy Lady. Having thus smoothed the lime of your intonaco, procure a glazed vessel; the vessèls should be all glazed and shaped like drinking or beer glasses, with a good heavy bottom that they may stand firmly and not spill the colours. Take as much as a bean of dark ochre (for there are two kinds of ochre, light and dark); and if you have no dark ochre, take light ochre ground very fine; put it into your vase, and take a little black the size of a lentil, mix it with the ochre; take a little bianco sangiovanni [lime-white] as much as the third of a bean, and as much light cinabrese as will lie on the point of a penknife; mix all these colours thoroughly together, and make them flowing and liquid with water, without tempera. Make a sharp brush of fine soft bristles, which may be introduced into the quill of a goose, and with this brush indicate with proper expression the face you are going to paint (remembering that the face is divided into three parts, namely, the forehead, the nose, and the chin, with the mouth), and with your brush nearly dry put on this colour, little by little, which is called in Florence verdaccio, and in Siena bazzèo. When you have sketched out the form of the face, if the proportions or any other thing should displease you, with a large brush steeped in water, by rubbing over the inton-

aco, you can efface and repair what you have done. Then take a little verde-terra, very liquid, in another vase, and with a hog's-bristle brush, without a point, squeezed with the fingers and thumb of the left hand, begin to shade under the chin, and all those parts of the face which should be darkest—under the lips, the corners of the mouth, under the nose, and under the eyebrows, making the shade darker near the nose, a little on the edge of the eye towards the ear; and in the same manner making out with judgment [*sentimento*] the whole face and hands, which are hereafter to be coloured with flesh-colour. Next take a pointed minever brush, and strengthen all the outlines of the nose, eyes, lips, and ears with the verdaccio. There are some masters who now, when the face is advanced thus far, take a little bianco sangiovanni tempered with water, and seek out the high lights and reliefs in proper order; then give the rosy colours to the lips and cheeks; then wash over the whole with the flesh-colours very liquid with water, and the colouring is done. It is a good plan to retouch afterwards the high lights with a little white. Some wash over the whole face with the flesh-colour first; they go picking out with a little verdaccio and flesh-colour, retouching with a little flesh-colour, and the work is finished. This

plan is adopted by those only who know but little of the art; but do you follow the method of colouring which I shall point out to you, because Giotto the great master followed it. He had Taddeo Gaddi the Florentine for his disciple for four-and-twenty years, who was his godson. Taddeo had Agnolo his son; Agnolo had me for twelve years, whereby I gained this manner of colouring, which Agnolo coloured with more charm and freshness than Taddeo his father.

"First take a small vase; put into it (a tiny morsel is enough) a little bianco sangiovanni, and a little light cinabrese, about as much of one as of the other. Temper them very liquid with clean water; then with a soft bristle-brush, squeezed between the finger and thumb as before, go over the face when you have finished putting it in with verde-terra; and with this red colour [*rossetta*] touch in the lips and the roses of the cheeks. My master was accustomed to put the colour in the cheeks nearer the ear than the nose, because it assisted in giving relief to the face, and then he softened the rosiness well into the surrounding colours. Then have three small vases, and make three shades of flesh-colour, so that the darkest may be darker by one-half than the rossetta, and the other two each lighter than the other

in regular gradations. Now take the little vase containing the lightest tint, and with a very soft bristle-brush without a point take some of this flesh-colour, squeezing the brush with the fingers, and pick out the reliefs of the face; then take the vase containing the middle tint of the flesh-colour, and paint the middle tint of the face, hands, and body, when you paint a naked figure. Afterwards take the third vase of flesh-colour, and go to the edges of the shadows, but always taking care at the contours that the verde-terra should not lose its value, and in this manner keep on softening one flesh-tint into another, until it is all covered as well as the nature of the work will permit. But mind that if you would have your work appear very brilliant, be careful to keep each tint of colour in its place, except that with skill you soften one delicately into the other. But seeing others work and practising with your hand, will make you perceive better than seeing it merely written. When you have painted in these carnations, make from them a tint much lighter—indeed almost white, and use this above the eyebrows, on the relief of the nose, the tip of the chin, and the upper eyelids; then take a sharp-pointed pencil of minever, and with pure white put in the whites of the eyes, and above the tip of the nose and a little on the fulness of the mouth

[*della proda della bocca*], and so touch tenderly such lights. Then put a little black into another vase, and with a brush mark out the outlines of the eyes above the lights of the eyes, and make the nostrils of the nose, and the holes within the ear. Then put some dark sinopia into another vase, paint the under outline of the eyes, the contour of the nose, the brows and the mouth, and shade a little under the upper lip, which must be a little darker than the under. Before you finish these outlines thus, take the said brush and with verdaccio retouch the hair; then with the said brush put on the lights of the hair with white, and with a watery wash of light ochre, and a soft bristle-brush cover over the hair as you did the carnations. Mark out the extremities of the shadows with dark ochre, then with a small and very pointed pencil of minever put on the lights of the hair with bianco sangiovanni and light ochre. Retouch the outlines and extremities of the hair with sinopia as you did on the face, all over. And this is sufficient for you for a youthful face."

It is evident from this account that we are here dealing with a new technique in which, after sketching in the figures in the wet lime, fresh plaster is laid over it bit by bit and finished the same day.

This method of fresco-painting, practised by the great painters during the highest development of Italian art, is what is more strictly to be described as buon fresco, and has obvious differences from the classical and Byzantine tradition; and no further description is required of the method of fresco-painting as carried out in the present day.

It will be noted that in this account a white is mentioned called bianco sangiovanni. The preparation of this white is thus described in chap. lviii.:—

"*Of the nature of bianco sangiovanni.*

"This is a natural white pigment, which however requires some preparation. It is prepared in this manner. Take very white slaked lime, pulverise it, and put it into a little tub for the space of eight days, changing the water every day and mixing the lime and water well together in order that it may throw off unctuous properties. Then make it into small cakes, put them upon the roof of the house in the sun, and the older the cakes are the whiter they become. If you wish to do it quickly and well, when the cakes are dry grind them on your slab with water and then make them into cakes and dry them again. Do this twice, and you will see what a per-

fect white it will become. This white must be ground with water, and thoroughly. It is good for working in fresco—that is, on walls without tempera; and without this colour you can do nothing—I mean you cannot paint flesh, or make tints of the other colours which are necessary in painting on walls, namely, in fresco; and it never requires any tempera."

This pigment is of peculiar interest after what we have already seen of the Byzantine practice of using chalk, of the practice of Theophilus of using lime, and of the chalk found in the pigments examined by Chevreul and obtained from St Médard.

These cakes of lime exposed to the air would be very largely reconverted into chalk by the carbonic acid gas of the atmosphere, but this conversion would take a very long time before it became complete.

This pigment, therefore, of Cennino Cennini would be superior to the lime of Theophilus, as it would be much whiter, and superior to the chalk of the monks of Mount Athos, as it would still contain free lime. It is in fact the ideal white pigment for the fresco-painter, and its use for fresco-painting should be revived.

Those wishing to read exactly how each tint was mixed must be referred to Cennino Cennini, but for our purpose the next chapter of importance is chap. lxxii.

"CHAPTER LXXII

"*The manner of colouring walls in secco, and in the proper temperas*

"Any of the colours used in painting in fresco may also be used in secco; but in fresco some colours cannot be used, as orpiment, cinnabar, azzuro della magna, minio, biacca, verderame, and lacca. Those which may be used in fresco are giallorino, bianco sangiovanni, black, ochre, cinabrese, sinopia, verde-terra, and amatisto. Colours used in fresco must be made lighter with bianco sangiovanni, and if you wish the greens to preserve their green tint, make them lighter with giallorino; when you would have them take the colour of sage, add bianco. Those colours which cannot be used in fresco must be made lighter by the addition of biacca, giallorino, and sometimes orpiment, but orpiment is very rarely used; indeed I think it superfluous. To make a light blue, take three of the same kind of small vase as I directed you to use when speaking of the carnation tints and cinabrese, and prepare them in the same manner, except that where you then used bianco,

you should now use biacca, and temper them all. Two sorts of tempera are good, but one is better than the other. The first tempera consists of the white and yolk of an egg, into which are put some cuttings of young shoots of a fig tree ; beat them well together ; then add some of this tempera moderately, neither too much nor too little, to each of the vases, like mixing half wine with half water ; then work with your colours, either white or green or red, as I directed you in fresco-painting ; and you will proceed with your draperies in the same manner as you did in fresco, with a careful hand, waiting, however, till it (the plaster) is dry. If you use too much tempera, suddenly the colour will crack and peel off the wall. Be wise and skilful. Remember, before you begin to work, if you wish to make a drapery of lake, or of any other colour, take a clean sponge, and having mixed the white and yolk of an egg with about two porringers full of clean water, and mixed them well together, with the sponge squeezed half dry pass this tempera over the whole of the space on which you have to paint in secco, and ornament in gold, and then colour freely as you please. The second kind of tempera is the yolk of the egg only ; and you must know that this tempera is of universal application on walls, on panels, and on iron, and you

cannot use too much of it, but be wise, and take a middle course. Before we proceed further, I would have you paint a drapery in secco in the same manner as you did in fresco, with cinabrese. Now I will have you make one of ultramarine blue. Take the three vases as usual; into the first put two parts azure and the third biacca; into the third, two parts biacca and one part azure: mix them and temper them as I have directed you. Then take the empty vase, that is to say, the second; put into it an equal quantity from each of the others, and stir all well together with a hog's-bristle brush, or, if you like, a minever brush blunt and firm; and with the first colour, that is to say, the darkest, go round the outlines, marking out the darkest folds. Then take the middle colour and lay the first tint of these dark folds, and mark out the light folds of the light side of the figure. Then take the third colour, and lay the flat tint of the light folds which come on the lighted side, and unite them with each other, softening and laying in the flat tints as I show you how to do in fresco. Take the lightest colour, add to it some biacca with tempera, and put on the high lights of the folds of the light part. Then take a little pure biacca, and retouch a few of the highest lights as the nude shape of the figure requires. Afterwards with pure ultramarine pick out

the darkest folds and outlines, in this way retouching [*leccando*, lit. licking] the drapery according to its situation and colours, without soiling or mixing them one with another except to soften them. And in this manner use lake and all other colours with which you work in secco."

The pigments mentioned here as safe for use on wet plaster are giallorino, bianco sangiovanni, black, ochre (yellow ochre), cinabrese (red ochre with lime), sinopia (red ochre), verde-terra (terre verte), amatisto (hæmatite); that is to say, with the exception of giallorino, merely black, white, and red, yellow, and green ochres. Giallorino is the pigment afterwards called Naples yellow, but in the time of Cennino Cennini and later seems to have been a native yellow pigment found in Mount Vesuvius, which was afterwards imitated by a fusion of compounds of lead and antimony. The artificial pigment is not to be recommended for use in fresco.

The remainder of the chapter explains how the difficulties of this limited palette are to be overcome by painting with egg on the dry surface. It will be noted that we have mentioned here as a medium the mixture of egg and fig-tree juice described by Pliny for medical purposes. In the later development of

fresco in Italy, however, such painting on the dry surface was not regarded as the highest development of the art, and consequently we find that Vasari, in his introduction on technique to his *Lives of the Painters*, gives the following directions about fresco (Miss Louisa S. Maclehose's translation, p. 221) :—

"*The Fresco Process*

"Of all the methods that painters employ, painting on the wall is the most masterly and beautiful, because it consists in doing in a single day that which, in the other methods, may be retouched day after day, over the work already done. Fresco was much used among the ancients, and the older masters among the moderns have continued to employ it. It is worked on the plaster while it is fresh, and must not be left till the day's portion is finished. The reason is that if there be any delay in painting, the plaster forms a certain slight crust, whether from heat or cold or currents of air or frost, whereby the whole work is stained and grows mouldy. To prevent this the wall that is to be painted must be kept continually moist; and the colours employed thereon must all be of earths and not metallic, and the white of calcined travertine. There is needed also a hand that is dexterous, resolute, and rapid, but most of all a sound and perfect judgment; because

while the wall is wet the colours show up in one fashion, and afterwards when dry they are no longer the same. Therefore, in these works done in fresco it is necessary that the judgment of the painter should play a more important part than his drawing, and that he should have for his guide the very greatest experience, it being supremely difficult to bring fresco work to perfection. Many of our artists excel in other kinds of work, that is, in oil or in tempera, but in this do not succeed, fresco being truly the most manly, most certain, most resolute and durable of all the other methods, and as time goes on it continually acquires infinitely more beauty and harmony than do the others. Exposed to the air, fresco throws off all impurities, water does not penetrate it, and it resists anything that would injure it. But beware of having to retouch it with colours that contain size prepared from parchment, or the yolk of egg, or gum, or tragacanth, as many painters do, for besides preventing the wall from showing up the work in all clearness, the colours become clouded by that retouching and in a short time turn black. Therefore, let those who desire to work on the wall work boldly in fresco, and not retouch in the dry, because, besides being a very poor thing in itself, it renders the life of the pictures short, as has been said in another place."

It will be noted that fresco white is lime, and is no longer the bianco sangiovanni of Cennino Cennini. It is evident from these accounts that while the method of fresco-painting had changed considerably, the tradition of using lime, either pure or partly calcinated, is an old one, and it is therefore highly probable that it was so used in the Pompeian frescoes and was the origin of the chalk found in the St Médard frescoes by Chevreul.

The use of pure chalk at Mount Athos is to be explained by the enormous excess of lime already present in the walls.

It is evident from these quotations from Cennino Cennini and Vasari that the method of fresco-painting during the great period in Italian art was quite different from the classical or the Byzantine method. The already dry plastered wall was wetted with water and covered with a thin plaster at the most not more than half a finger in thickness, composed of fine sand and lime which had been slaked in water for twelve months, in the proportion of one of lime to two of sand. Fine river sand was preferred for this purpose. According to the practice in Cennino Cennini's time, a complete sketch of the final fresco was drawn upon the wall, and then each day a small portion was plastered and the wet

painting finished and the unpainted-on plaster cut away.

In the time of Michael Angelo the practice was somewhat different. A complete cartoon of the final picture was prepared on paper spread over the wall. This picture was then cut up into numbered squares of convenient size for one day's painting. The plaster wall was thoroughly wetted the night before, and next morning the thin plaster laid on, the outlines of the design marked through the paper on the wet surface with a point, and then the painting finished. All authorities agree that if the painting is not finished the same day, a kind of skin forms on the plaster, and the colouring gets spotty. This is probably due to the rapid drying of the thin layer. The experiments I have made on properly closed-in marble-dust plaster with a thick backing (about one inch in my experiments) of still damp plaster behind reveals no such peculiarities. The colour is brilliant and fresh on the creamy white glistening surface, whether laid on one day or the next.

If—to return to the sixteenth-century practice—the painting was not complete in one day, the plaster had then to be allowed to dry and the picture finished in secco with size or egg. Such finishing was deprecated, but was evidently frequently found necessary.

It is also evident from Cennino Cennini's account that there was difficulty in his time at any rate, about a suitable blue, as he mentions no blue in his list of pigments to be laid on the wet lime. In the chapter dealing with Cennino Cennini's pigments it will be found that he was familiar with two blues—ultramarine, from lapis lazuli, and blue carbonate of copper ore. Of these, there is no reason to suppose that ultramarine is not perfectly safe to use on wet plaster, and it was therefore probably on account of its being so expensive that it was used sparingly on the finished dry wall where necessary with egg. The copper ore was not likely to stand the action of wet lime, and all knowledge of the Egyptian frit seems to have disappeared. In writers of the sixteenth century, however, another blue is mentioned, smalto, which is, as they say, "a glass," and which they recommend for use on the wet lime. This blue came from Germany, and the modern smalt from the same source is a glass coloured blue with cobalt. We have seen that the use of cobalt in glazes was known in Egyptian times, but there is no trace of a cobalt glass being used as a pigment. There seems to be some doubt as to whether this smalto of the sixteenth-century painters was always or from the beginning coloured with cobalt, or whether in some instances it was a re-

newal of the old Egyptian frit coloured with copper. At any rate, whether coloured with copper or cobalt, if properly made it should have been quite suitable for putting on the wet lime, and as durable as the old Egyptian frit has proved. The fading of the blue in many old Italian frescoes is probably due to unsuitable blues, like the native copper ore, or indigo, having been used. The modern artist, with oxide of chromium greens (viridian) and cobalt blue, is much better equipped for fresco-painting than Cennino Cennini or Michael Angelo.

The only attempt to revive the classical method of which we have record is to be found in commentaries on Vitruvius by Guevara, written in Spanish about 1550, and in the directions for plastering by Alberti, 1452. Guevara was a great antiquarian and seems to have travelled widely, and his situation at the court of Charles the Fifth and Philip the Second gave him plenty of opportunities for study and for collecting information. He gives a very complete account of the directions of Vitruvius, and dwells on the importance of thick coats and careful polishing, and suggests that when marble cannot be obtained white pebbles can be ground up, and he criticises the methods of fresco-painting of his time and gives directions for keeping the wall damp.

The directions given by Alberti are also of great interest.

He advises three plasterings, the first rough plaster containing pit sand and pounded brick the size of acorns, and attached to the wall by driving bits of flint between the stones of the wall to make a rough grip to the surface; then a second rough coat, made with river sand; and then the final coat, on which the painting is done, which need not be more than half a finger's-breadth in thickness. A white stone should be used instead of sand. This white stone is, he says, found in quarries, consisting of marbly veins which resemble alabaster but are neither marble nor gesso, and which sparkle when pounded. He directs the lime to be worked up again and again for at least three months with plenty of water, and well pounded and mixed with the sand. When in proper condition it should not stick to the trowel. The third coat is to be laid on the still wet sand coat, and well smoothed and rubbed till it shines like glass. He also says that the final surface can be treated with wax and mastic driven in by heat or polished with a little soap; and then discusses the casting of small figures and objects in relief. There is then only a brief reference to painting on this surface, which

he says may be done in fresco, secco, or with linseed oil.

Leon Batista Alberti wrote *De re Ædificatoria* about 1452, and deals principally with architecture. It is evident that he is considering the methods of preparing fine plastered surfaces rather than the technique of wall-painting; and while his methods, which are based on Vitruvius, were probably followed for such purposes, they do not seem to have influenced the recognised buon fresco technique.

The polishing with soap is interesting, as it corresponds to the modern Italian stucco lustro process of making imitation marble in which Herr Berger believes he has found the ancient method of wall-painting. The bianco sangiovanni of Cennino Cennini seems to have been replaced by well-slaked calcined travertine. This would probably not be quite so pure and opaque a white, but would equally well serve to cement the pigments to the wall. The extraordinary facility obtained in this kind of painting can be measured by the following quotation from Vasari:—

"Amico Aspertino painted with both hands at once, holding in one hand a brush filled with light colour and in the other one filled with dark; but what was more remarkable and laughable was that

he bound round his waist a leather strap to which hung his gallipots of tempered colours; and he looked like the devil of St Maccario with all his phials hanging round him, and when painting with his spectacles on his nose, it was enough to make the very stones laugh, especially when he began to talk, for he talked enough for twenty persons, and he loved to say the strangest things in the world."

The modern practice of fresco, which is closely copied from the sixteenth-century methods, is fully described by James Ward in his *Fresco-Painting*, and practised with great perfection by Sir Frederick Leighton in his fresco at South Kensington Museum. The directions given by Mr Ward are scientifically sound except in two respects. For the final coat he advises three-quarters of sand to one-quarter of lime. This seems to me too high a proportion of sand to make a durable surface. Both Pacheco (1641) and Palomino (1715) recommend half and half. Cennino Cennini with *fresh* lime recommends one-third lime to two-thirds sand. In his list of pigments he excludes yellow ochre for quite an inadequate reason, more especially as he includes raw sienna. Yellow ochre is absolutely permanent and without injurious effects of any kind. He furthermore replaces it by cadmium yellow. There are two objections to cad-

mium yellow. One is that unless prepared by most particular methods it is fugitive. Most of the pale cadmiums in the market are fugitive, and only orange cadmium and certain special preparations are reliable. In the second place, cadmium yellow strikes too high a colour key, if the rest of the work is to be done in earth colours, and spoils the dignity and harmony of the work.

He should also include among his greens terre verte. This was the favourite green of the old masters in fresco-painting ; and though most of the terre verte sold is an imitation, it is still possible to obtain the genuine green, which has just the qualities wanted in fresco. On the whole, vermilion is also better excluded, leaving on the ideal palette lime white, the blacks, the yellow ochres and raw siennas, light or Venetian red, burnt sienna and Indian red, the opaque and hydrated oxides of chromium (viridian), cobalt greens and blues, and the umbers if desired. The umbers are not necessary, and are never mentioned among fifteenth- and sixteenth-century pigments. If necessary a far larger range of tint from red to violet can be got in oxides of iron (Venetian and Indian red) than are supplied by the artist's colourman. A fresco-painter should therefore ask to be supplied with the whole range.

With these additions and corrections Mr Ward's book is a thoroughly reliable manual for those who wish to practise the buon fresco of the sixteenth century, and contains one valuable suggestion unknown to the older painters, namely, the introduction of asbestos into the plaster to bind it together. The beautiful and probably more permanent classical methods require careful working out in practice from the hints already supplied.

The following quotations from Mrs Merrifield's translation of the actual text of Alberti are of value for those engaged in permanent plasterings.

He observes (lib. vi. ch. ix.) "that in all plasterings three kinds, at least, of *intonachi* are required. The first is called *rinzaffato*, and its use is to adhere very closely to the wall, and to hold firmly the other two *intonachi* which are laid upon it. The use of the last *intonaco* is to receive the polish, and the colours and lineaments, which make the work pleasing. The use of the middle *intonaco*, which is now called *arricciato*, is to obviate any defects both in the first and in the last *intonaco*. The defects are as follows :—If the two last coats, namely, the *arricciato* and the *intonaco*, are caustic, and, so to speak, astringent, as the *rinzaffato* ought to be, they will, on account of their crudity, show many cracks as

they dry. And if the *rinzaffato* is mild, as the *intonaco* should be, it will not adhere sufficiently to the wall, but will fall off in pieces. The more coats of it are given, the better will the surface receive the polish and be enabled to withstand the effects of the weather. I have seen some of the more ancient specimens which had nine coats, one upon the other. It is necessary for the first of these to be rough, containing pit sand and pounded brick, the pieces of which should not be too small, but as big as acorns, or in pieces the size of the finger, and sometimes the size of a palm. For the *arricciato*, river sand is best, being less liable to crack ; this *arricciato* should also be rough, because the coats which are to be laid on afterwards will not adhere to smooth surfaces. The last coat must be very white, like marble ; in fact, very white pounded stone should be used instead of sand, and it will be sufficient for this coat to be half a finger's-breadth in thickness, because, if it is made too thick, it dries with difficulty. I have seen some persons, who, in order to save expense, do not make this coat thicker than the sole of a shoe. The *arricciato* must be mixed according as it is nearer to the first, or to the second coat. In the masses of stone, in stone-quarries, there are found certain veins, very much resembling transparent alabaster,

which are neither marble nor *gesso*, but of a certain middle nature, between the one and the other, and which are very apt to crumble. When these are pounded, and used instead of sand, they sparkle like shining marble. In many places are seen sharp points projecting from the wall, in order to hold the *intonachi*; and time has shown us that these are better made of bronze than of iron. I approve very much of those who, instead of nails, insert between the stones certain pieces of stone, or flints, so as to project; but, for this purpose, a wooden mallet must be used, and the fresher and rougher the wall is, the better it will hold the *rinzaffato*, the *arricciato*, and the *intonaco*; therefore, if, while building, and while the work is being done, you apply the *rinzaffato*, although thinly, you will cause the *arricciato* and the *intonaco* to adhere to it very strongly—so as never to separate. You may carry on any of these processes during the prevalence of the south wind; but if you apply the *intonaco* while the north wind blows, or during severe cold, or great heat, the *intonaco* will immediately become rough or uneven.

"Slake the lime with clear water in a covered trough, and with so much water that there may be a great excess above the lime; then stir it well with the spade, kneading and working it thoroughly;

and let it be thoroughly slaked and kneaded, which may be known by the spade not meeting with any lumps or clods. The lime is not considered to be mature in less than three months. That which is good must be very soft and viscid; because, if the trowel put into it comes out dry, it proves that it has not had enough water to slake it completely. When you mix it with the sand, or with any powdered materials, work it again and again with great labour; and continue to work it until it almost froths. The ancients were accustomed to pound in a mortar the materials they required for the *intonachi*; and they tempered the mixture so that it might not adhere to the trowel when they were laying it on the wall. Upon the coat which has just been put on, and while it is still wet and soft, another coat must be laid, and care must be taken that all these coatings may dry together, and at the same instant. They must be smoothed and made even with smoothing boards, floats, and other similar things while they are yet soft. If the last coat of pure white be well rubbed it will shine like a looking-glass; and if, when the same is nearly dry, you anoint it with wax and mastic, liquefied with a very little oil, and then heat the wall, so anointed, with a chafing-dish of lighted charcoal, or with an iron, so that it may soak up the ointment,

it will surpass marble in whiteness. I have found by experience that such *intonachi* never cracked, if, in making them, the moment the little cracks begin to appear they are rubbed down with bundles of twigs of the wild mallow, or of wild broom. But if, on any occasion, you have to apply an *intonaco* in the dog-days, or in very hot places, pound and cut up, very finely, some old rope, and mix it with the *intonaco*. Besides this, it will be very delicately polished if you throw on it a little white soap, dissolved in tepid water. If it is too greasy, it will become pale.

"Small figures of stucco may be executed very expeditiously by casting from hollow moulds; and the hollow moulds may be obtained from *rilievos*, by pouring liquid gesso over them. When they are dry, if they are anointed with the composition which I have mentioned, they will have a surface like marble."

CHAPTER IX

THE MS. OF THE MONK THEOPHILUS

After the works of Pliny there is very little information to be found as to the painting processes until we come to a manuscript which has been already quoted from and is in the library of the Cathedral of Lucca, known as the Lucca Manuscript, and which has been reproduced somewhat incorrectly by Muratori in his work on *Italian Antiquities.* The only other two references of earlier date have also been already mentioned—viz. the description in the Thebes papyrus of a painting medium, and the reference to the use of drying oil for varnish by the physician Aëtius. I do not propose to dwell here upon the information contained in the Lucca Manuscript beyond repeating one sentence which is of considerable importance as indicating what methods were in use at that time :—

"Ita memoramus omnium operationes quae in

parietibus simplice in ligno cere commixtis coloribus in pellibus ictiocollon commixtum."

"Thus we mention operations with all of them, on walls unmixed, on wood the colours being mixed with wax, on skins fish-glue being mixed."

It is evident from this quotation that painting upon walls in buon fresco and painting upon wood with wax was still customary, while fish-glue was the medium used for painting upon parchment. The Lucca Manuscript is also of interest because it contains the first receipt for the preparation of artificial vermilion, and also contains one or two receipts for varnishes. The greater part of the Lucca Manuscript is repeated in the *Mappæ Clavicula*, a manuscript of the twelfth century, and another very important and interesting manuscript of about this date is the *Schedula Diversarum Artium* of Theophilus. It has been edited by Hendrie, and has since also been published at Vienna in Eitelberger von Edelberg's *Quellenschriften für Kunstgeschichte*. Later than these we have the manuscripts which were translated by Mrs Merrifield—viz., *Eraclius*, *Alcherius*, and the book of Peter, St Audemar, all included in the manuscripts of Le Bègue, the Sloane MS., the anonymous Bernensis, and the Strassburg MS. We have not space to consider all these manuscripts in

detail, with the exception of Theophilus; but it will be of some interest to pick out from them certain receipts which throw light upon the methods employed during the Middle Ages, and later for painting and illuminating. The first of these receipts of special interest is the one for the preparation of real ultramarine, which we find given in the manuscript of Le Bègue; but it is not mentioned in the MS. by Theophilus to which reference has already been made. As already stated, there is no evidence that the preparation of ultramarine from lapis lazuli was understood in classical times. The amount of actual colouring matter to be found in lapis lazuli is very small, and if the stone is pounded down it merely appears to be of a light grey. It is possible by floating and fine grinding repeatedly carried out to ultimately separate the ultramarine or real colouring matter from the rest of the stone, but the process is tedious and difficult. Ultramarine when finally extracted is a remarkable chemical compound, containing soda, silica, alumina, and sulphur. It has long been a puzzle to the chemists to understand exactly its constitution, and many experiments have been made with the aim of clearing up what compounds it contains. It can, however, be prepared artificially, and the artificial manufacture of ultramarine by

roasting together these substances is now carried on on a large scale in many places, and the artificial ultramarine so produced is used for ordinary painting purposes and as an artist's pigment. It is not, however, quite so subtile in colour as the real ultramarine, being somewhat crude and violet in tint, while the real ultramarine is a most delicate and perfect blue. It is seldom to be seen in modern pictures, as it is a very expensive pigment and can be replaced by other blues. But for purely decorative treatment of a surface, such as illuminated manuscript, it is questionable whether any blue could really replace it, although native copper blue, which has already been described, comes very near it in beauty. The receipt for preparing it, given by Le Bègue, is similar to receipts to be found in other manuscripts, and must have been the recognised process for its preparation. It is almost exactly the same as the receipt shortly to be quoted from Cennino Cennini, so need not be quoted here.

While dealing with the question of pigments, we have to consider very fully what lakes were used during these times, and it is only here that we find very much to add to the description of pigments which has already been given in the classical part of the book. The materials for preparing lakes were

very much the same as before, with the addition of dye-woods such as sandal- or Brazil-wood. Yellow lakes were prepared from citron bark, from weld, and from Persian berries, but these materials were probably made use of for the same purpose in classical times. It is rather in the actual detailed receipts which we now obtain for the first time that fresh light is thrown upon the processes which were made use of, and also in the replacing of opaque by transparent lakes. Before going further and quoting these receipts, there are one or two points of interest to be noted about them. In the first place, it should be noted that madder is seldom referred to, the receipts for the preparation of red lakes being nearly all for the preparation of lakes from kermes or from dye-woods, or from red cloth from which the dye was extracted. It is, of course, possible that where the red cloth was used the dye may have been madder. After the discovery of an Egyptian madder lake and the distinct references to it by Vitruvius, it is curious to find the absence of such reference in these treatises of the twelfth, thirteenth, and fourteenth centuries. The next point to be noted is that these lakes without exception are fugitive when exposed to light, and would be rejected from the modern artist's paint-box upon that account. We are there-

fore faced with the puzzling problem of how such lakes, when used by the early painters, could have been so permanent as they have proved to be. There are many pigments to be seen not only upon illuminated manuscripts which have, of course, not been exposed to the light, but also upon pictures of the fourteenth and fifteenth centuries, which could only have been produced by means of lake, and which have stood remarkably the test of time. Among other things there is a pink seen in Fra Angelico's pictures which I have never been able to detect anywhere else, and it is very difficult to tell from what pigment it is produced. I cannot help suspecting that the permanency of these lakes in many cases shows that madder lakes were actually in use, but possibly prepared in many cases after the Egyptian receipt, and that this, at any rate, is one explanation of the durability of these pigments where they appear.

The question of the preparation of lakes will, however, require a chapter to itself, and in the meantime we shall proceed to the more detailed consideration of the most interesting of the existing MSS., before that of Cennino Cennini, namely, the *Diversarum Artium Schedula* of Theophilus.

While it is true so little information has come down to us of painting methods between the first

and the eleventh and twelfth centuries, yet it must not be supposed that these centuries had been sterile of invention, and that no new improvements and discoveries had been made.

While the Roman Empire was breaking up in the West, it continued to exist in the East until the Mohammedan conquest, and this period saw the rise and development of Byzantine art. Nor were the sister arts and sciences necessarily stagnant. The discoveries of the alchemists of Alexandria became the inheritance of their Mohammedan conquerors, and under the Arabs learning and civilisation rapidly progressed, and schools were established at Baghdad, Alexandria, Cairo and Cordova. Charlemagne had not neglected the decoration of the cathedrals, and in the quiet monasteries of Ireland, far removed from the turmoils of Europe, the monks were bringing to perfection the art of illuminating manuscripts. Moreover, the learned monastic orders were everywhere growing stronger from year to year, and bringing together all the knowledge of the past under the shadow of the Church, and the eleventh century had seen the rise of the universities, true children of the classical schools of philosophy.

The first manuscript, therefore, which we shall have to consider comes to us from the monasteries,

where every craft was practised by the monks for the glory of God. For, besides the pursuit of agriculture and other useful crafts, the monks devoted themselves more especially to the artistic crafts, in order that the house of God might be richly embellished and the people taught the truths of Christianity and the lives of the saints through pictorial representations. Dedicated to a life of poverty and possessing no individual property, and looking to a future life for their reward, they devoted every thought and faculty to the one pious purpose, and out of this grew the exquisite art of illumination, the perfection of Gothic architecture, the craft of painting on panel and on wall, and the glories of stained glass. Even when the art of painting ceased to be carried on by the monks and became the object of the professional artist, the skill in preparing certain pigments still remained in the monastery, and the artist himself engaged in sacred pictures at first preserved towards his craft the religious feeling by which the monks had been inspired.

There is no blasphemy, therefore, no thought of irreverence, in directing the measurement of time while a pot of colour is boiling by the repetition of paternosters. The decoration of the church was itself an act of prayer, and all that appertained to it,

such as the preparation of a pigment, was therefore an act of devotion. When, therefore, we come to examine the MS. of the monk Theophilus, an unknown inhabitant of some German monastery, we find this spirit pervades the whole, and is beautifully expressed in the prefaces by which each book dealing with some artistic craft is introduced. Of these the preface to the third book, dealing with the working of metals, is the most beautiful, and is worthy of quotation as one of the most perfect revelations of the thought and feeling of a monk engaged in artistic crafts in a medieval monastery.

Nothing is known of Theophilus, but it is probable from internal evidence that he travelled far and wide, even as far as Constantinople, to collect his receipts, and his elaborate defence of the duty of decorating the house of God is perhaps an answer to the iconoclasts, and the persecution of the artists in the eighth and ninth centuries, begun under Leo the Isaurian. His work is divided into three books, the first of which deals with painting, the second with glass manufacture, and the third with work in the metals, and the title of the MS. is "*Diversarum Artium Schedula*, by Theophilus, called also Rugerus."

Before considering briefly the book dealing with painting, I shall quote in full the whole of the

beautiful preface to the third book as a revelation of the attitude towards art and religion of a monk of the Middle Ages. For the following translation of it I am myself responsibile, as the rendering given by Hendrie does not quite satisfy me. Since making my version I have read with pleasure the translation by Mr Coulton in his *Medieval Garner*.

"*Preface to the Third Book of 'Diversarum Artium Schedula,' by Theophilus*

"David, of special excellence among the prophets, whom God foreknew and predestined before time was, and whom, because of his simple and humble mind, he chose as one after his own heart, and made a prince over his own people, and strengthened him with his holy spirit that he might rule with the nobility and prudence worthy of so great a name; with all his mind intent on love of his Maker, spoke these among many other words, 'Domine, dilexi decorem domus tuæ.' And it is lawful for a man of such authority and such breadth of understanding to speak of the habitation of the celestial host in which God rules with inestimable brightness over the hymns of the celestial choirs as a house; towards which indeed his very bowels yearned, saying: 'Unam petii a Domino, hanc requiram, ut inhabi-

tem in domo Domini omnibus diebus vitæ meæ' ; or as the sanctuary of a faithful breast and purest heart in which verily God dwelt ; a refuge for which the same glowing desire again breathes forth in prayer, 'Spiritum rectum innova in visceribus meis, Domine.' Nevertheless, it is certain that he longed to make beautiful the earthly House of God, the place of prayer. For he made over to Solomon his son almost all the treasures in gold and in silver, in brass and in iron, of the House, of which he himself had desired with the most ardent passion to be the author, a privilege denied to him because of the frequent spilling of human though hostile blood. For he had read in Exodus that God had given to Moses the command to build the tabernacle, and had chosen by name the masters of the work, and had made them full of the spirit of wisdom, understanding, and knowledge for the designing and making of things in gold and silver, in brass and precious stones and wood, and in every kind of craftsmanship ; and through devout meditation he knew that God was graciously pleased with such furnishings, which he designed to be put together under the guidance and influence of his Holy Spirit ; and he believed that nothing of this kind could possibly be brought to pass without the divine impulse.

"Therefore, beloved Son, do not hesitate, but with abundant faith believe that the Spirit of God has filled thy heart, since thou hast furnished the House in so comely a manner and with so many diverse works of art; and lest perchance thou shouldst be distrustful, I will clearly and reasonably prove that whatsoever of craftsmanship thou art able to learn, to comprehend, or to invent is gifted to thee by the favour of the sevenfold spirit.

"Through the spirit of wisdom thou knowest that all created things proceed from God, and without him nothing is; through the spirit of understanding thou art become capable of invention, in whatsoever order, variety, or measure thou wouldst exercise it on various works of art; through the spirit of counsel thou hidest not the talent gifted to thee by God, but with all humility labourest openly, and teachest loyally, showing everything to those desirous of learning; through the spirit of ghostly strength thou dost shake off all slothful lethargy and completest with abundant force whatever thou hast diligently begun without delay; through the spirit of knowledge with which thou hast been endowed thou controllest thy invention from an abundant heart, and that which flows out in perfect form from thy well-stored mind thou boldly usest for the good

of all ; through the spirit of true godliness thou dost direct the time, the manner, and the quantity of thy work ; and lest the vice of avarice and greed should creep in, thou dost fix the price of thy labours by a pious consideration of the virtues of moderation ; through the spirit of the holy fear thou dost reflect that thou art able to do nothing from thyself, and that thou canst neither possess nor will anything except through the gift of God ; but, believing, trusting, giving thanks, thou ascribest to divine compassion what thou knowest, what thou art, and what thou art able to be.

"Having drawn near, O dearest Son, to the House of God with a confidence inspired by these covenants with the virtues, thou hast adorned with so much grace both walls and ceilings with different works and with different colours, setting forth the semblance of the paradise of God blooming with all kinds of flowers, green with grass and leaves, cherishing the souls of the saints with crowns of varied worth. Thou hast in a measure disclosed to the beholders everything created praising God its maker, and hast caused them to proclaim him wonderful in all his works. Nor can the eye of man decide upon which work first to fix his glance : if he beholds the ceilings, they bloom like tapestries ; if he

regards the walls, they have the splendour of paradise; if he looks up to the wealth of light from the windows, he admires the marvellous beauty of the glass and the variety of that glorious work. And if perchance a faithful soul beholds an image of our Lord's Passion revealed in drawing, he is pierced with compassion; if he beholds what torments the saints have endured in their own bodies and what rewards reaped in the life of eternity, he lays hold on the lesson to observe a better life; if he beholds the joy of heaven and the torments of the flames of hell, he is inspired with hope through his own good deeds and is shaken with terror by reflecting on his sins.

"Act therefore now, virtuous man, happy before God and men in this life, happier in the future life, through whose labour and zeal so many sacrifices are offered up before God; henceforth be kindled by a more splendid genius, and begin with the full exertion of thy mind those things which are still wanting among the utensils of the House of the Lord. These are the chalices, candelabra, incense-burners, vials, pitchers, caskets of sacred relics, crosses, missals, and other things which are required as needful and expedient for the ceremonies of the Church.

"If thou wouldst fashion these, thou must begin in the following order."

The book on painting which has already been referred to, consists of forty chapters, and deals largely with the mixing and laying on of tints for producing various effects. The first fourteen chapters are thus occupied, the fifteenth chapter containing the directions for painting on walls which have been already quoted. In this chapter on wall-painting yolk of egg is also mentioned as a medium.

In the seventeenth chapter instructions are given for preparing a glue by taking cheese, washing it, grinding it fine, and making into a paste with quicklime. This glue was used for fixing together wooden objects, such as pieces of panel. Such panels, after smoothing, are directed to be covered with the untanned skin of a horse or ass, cemented on with the cheese-glue. After this skin is dry, ordinary glue is prepared by boiling down the cuttings of skin and stag-horn. This glue is then mixed with chalk or slaked gypsum and painted on the skin in a series of thin coats. When dry it is smoothed and polished with the herb called shave-grass.

The directions for preparing a panel for painting on are very interesting and thoroughly sound. We shall consider later the modifications on this practice to be found later, during the best time of Italian tempera painting.

"CHAPTER XVII

"Of the tablets of altars and doors and of the glue of cheese

"The tablets of altars, or of doors, are first carefully fitted together with the joining instrument which carpenters or vat-makers use; they are then joined with the glue of cheese, which is made in this manner:—Soft cheese is cut very small, and is washed with warm water in a small mortar with a pestle until, being frequently poured in, the water comes away pure. Then this cheese, compressed by the hand, is put into cold water until it hardens. After this it is very finely ground, with another piece of wood, upon a smooth wooden table, and in this state it is again placed in the mortar, and is carefully ground with a pestle, water mixed with quicklime being added until it is made as thick as lees. The tablets of altars fastened together with this glue, after they are dry, so adhere together that neither heat nor humidity are able to disjoin them. They should afterwards be smoothed with a planing iron, which, curved and sharp inside, has two handles, so that it may be drawn by both hands (with which doors and shields are shaved), until they are made perfectly smooth. They are then covered with the

untanned skin of a horse, or ass, which is soaked in water; as soon as the hairs have been scraped off, some water is squeezed from it, and, thus moist, it is superposed with the curd glue.

"CHAPTER XVIII

"Of glue of skins and stag-horns

"The above being carefully dried, take cuttings of the same skins, dried in like manner, and carefully cut them up into small pieces, and taking the stag-horns, broken very small with a smith's hammer upon an anvil, place them together in a new pot, until it is half full, and fill it up with water, and so apply fire until a third part of this water be evaporated, so, however, that it may not boil. And you will thus try it: moisten your fingers with this water, and if, when they have become cool, they adhere together, the glue is good; but if not, cook it until they do adhere together. Then pour this glue into a clean vessel and again fill the pot with water, and simmer it as before; and do this four times.

"CHAPTER XIX

"Of the white ground of gypsum

"After this take gypsum, burnt like lime, or chalk with which skins are whitened, and carefully grind

it with water upon a stone, then place it in a baked earthen vessel, and, pouring in some glue made from skins, place it over the coals, that the glue may liquefy, and in this manner paint over the skin very thinly with a pencil, and when it is dry, paint somewhat thicker, and, if needed, paint a third time. When it is quite dry, take the herb called shave-grass which grows like a bulrush, and is ragged; when you have gathered it in summer you will dry it in the sun, and will rub this whitening with it until it is made everywhere smooth and polished.[1]"

The following are, however, the most interesting chapters, as they are the earliest account we possess of oil-painting :—

"CHAPTER XX

"*Of reddening doors, and of linseed oil*

"If, however, you wish to redden panels, take linseed oil, which you make in this manner :—Take linseed and dry it in a pan over the fire, without water. Then put it into a mortar and bruise it with the pestle until it becomes a very fine powder; placing it again in the pan, and pouring a little water upon

[1] "But if a skin is wanted for covering tablets, they are covered with canvas not too new, with the same glue and in the same manner."—*Cod. Guelph. et Harlei. in fine*, cap. 21.

it, make it thus very hot. Afterwards fold it in a new cloth and place it in the press, in which olive, or walnut, or poppy oil is accustomed to be expressed, that this also may be expressed in the same manner. With this oil grind minium, or cinnabar, upon the stone, without water, and paint over the doors or tablets, which you wish to redden, with a pencil, and you will dry them in the sun. Then paint them again, and again dry them. At last cover them over with that gluten which is called varnish, and which is made in this manner."

This method of expressing the linseed oil agrees with modern practice, but no account is given of how to refine it or how to convert it into a drying oil. Such an unrefined oil would dry rather slowly, and the painting would therefore be the better of exposure to the sun.

In the two following chapters two receipts are given for making varnishes. These receipts will have to be considered more fully elsewhere.

"CHAPTER XXI

"*Of the varnish gluten*

"Put linseed oil into a small new pot, and add, very finely powdered, the gum which is called fornis,

which has the appearance of the most lucid Thus, but, when broken, it yields a brighter lustre. When you have placed which over the fire, cook carefully, so that it may not boil up, until a third part is consumed, and guard against the flame, because it is very dangerous and is extinguished with difficulty if it be raised. Every painting, covered over with this gluten, is made both beautiful and for ever durable.

"CHAPTER XXII

"*Of the same*

"Place together four stones which may be able to sustain the fire without flying to pieces, and place a common pot upon them, and put into it the abovementioned gum fornis, which in Romaic is called glassa, and upon the mouth of this pot place a smaller pot, which has a small hole in the bottom, and lute a paste round it, so that no vapour may come out between these pots. Then place fire carefully underneath, until this gum liquefy. You will also have a thin iron rod fitted to a handle, with which you will stir this gum, and with which you can feel when it is quite liquid. Have also a third pot nigh, placed upon the coals, in which is hot linseed oil, and when the gum is quite liquid, so that the iron being extracted a kind of thread is drawn

out with it, pour the hot oil into it and stir it with the iron, and thus cook them together that they boil not violently, and at times draw out the iron and daub a little over a piece of wood or stone, to try its substance. And take care in this, that in weight there are two parts of oil and the third part of gum. And when you have carefully cooked it to your wish, removing it from the fire and uncovering it, allow it to cool."

In chapter xxiv. directions are given for hammering out gold leaf, and in chapter xxv. directions for laying it on, which correspond closely with those given by Pliny.

"CHAPTER XXV

"*Of laying on the gold*

"In laying on gold take the clear part of the white of egg, which is beat up without water, and then with a pencil paint lightly over the place in which the gold is to be placed, and, the handle of the same pencil being wetted in your mouth, touch one corner of the cut leaf, and so elevating it, lay it on with the greatest quickness, and spread it even with a brush. And at that moment you must beware of a current of air and refrain from breathing, because if you blow you lose the leaf and with difficulty recover it. When this is laid on and dried, superpose

another upon it, if you wish, in the same manner, and a third likewise, if it is necessary, that you may be able to polish it more brightly with a tooth or a stone. You can also, if you wish, lay this leaf upon a wall, and on a ceiling, in the same manner. But if you have not gold, take a leaf of tin, which you make in this manner."

In chapter xxvi. directions are given for the laying on of tin leaf and giving it a tint like gold by means of a saffron-tinted varnish. The leaf is finally to be cemented on the surface with skin glue and painted on with oil-paints, "grinding them carefully with linseed oil without water; and make tints for faces and draperies as you before made with water, and you will vary beasts, birds, or leaves in their colours as it may please you." It is evident from this that elaborate oil-painting was thoroughly understood. In the next chapter, however, we are again warned that only things which can be dried in the sun can be painted in oil.

"CHAPTER XXVII

"*Of colours ground with oil and gum*

"All sorts of colours can be ground and laid upon woodwork, with the same kind of oil, in those things only which can be dried in the sun; because each

time that you have laid on one colour, you cannot superpose another upon it until the first has dried, which, for figures, is excessively long and tedious. If, however, you wish to hasten your work, take gum which exudes from the cherry or plum tree, and, cutting it up very small, place it in an earthenware pot, and pour water upon it abundantly and place it in the sun, or in winter upon the coals, until the gum has liquefied; and mix it together with a smooth piece of wood. Then strain it through a cloth, and grind the colours with it and lay them on. All colours and their mixtures can be ground and laid on with this kind of oil, except minium and ceruse and carmine, which are ground and laid on with white of egg. Spanish green is not mixed with succus under the gluten, but is laid on by itself with gum gluten. You can otherwise mix it if you wish it."

In chapter xxx. directions are given for grinding gold for illuminating books, which is afterwards to be mixed with fish-glue. Then come the following directions :—

"CHAPTER XXXI

"*How gold and silver are laid in books*

"Afterwards take pure minium and add to it a third part of cinnabar, grinding it upon a stone with water.

Which being carefully ground, beat up the clear of the white of an egg, in summer with water, in winter without water, and when it is clear, put the minium into a horn and pour the clear upon it, and stir it a little with a piece of wood put into it, and with a pencil fill up all places with it upon which you wish to lay gold. Then place a little pot with glue over the fire, and when it is liquefied, pour it into the shell of gold and wash it with it. When you have poured which into another shell, in which the purifying is kept, again pour in warm glue, and, holding it in the palm of the left hand, stir it carefully with the pencil, and lay it on where you wish thick or thin, so, however, that there be little glue, because, should it exceed, it blackens the gold and does not receive a polish. But after it has dried, polish it with a tooth or bloodstone carefully filed and polished, upon a smooth and shining horn tablet. But should it happen, through negligence of the glue not being well cooked, that the gold pulverises in rubbing, or rises on account of too great thickness, have near you some old clear of egg beat up without water, and directly with a pencil paint slightly and quickly with it over the gold; when it is dry, again rub it with the tooth or stone. Lay in this manner silver, brass, and copper in their place, and polish them."

Then in the following chapter we have further instructions for the preparation of a glue suitable for illuminating purposes and the directions for tempering colours.

"CHAPTER XXXIII

"*Of every sort of glue for a picture of gold*

"If you have not a bladder, cut up thick parchment of vellum in the same manner, wash and cook it. Prepare also the skin of an eel carefully scraped, cut up and washed in the same manner. Prepare thus also the bones of the head of the wolf-fish washed and dried, carefully washed in warm water three times. To whichever of these you have prepared, add a third part of very transparent gum, simmer it a little, and you can keep it as long as you wish.

"CHAPTER XXXIV

"*How colours are tempered for books*

"These things thus accomplished, make a mixture of the clearest gum and water as above, and temper all colours except green and ceruse and minium and carmine. Salt green is worth nothing for books. You will temper Spanish green with pure wine, and if you wish to make shadows, add a little sap of iris

or cabbage or leek. You will temper minium and ceruse and carmine with clear of egg. Compose all preparations of colours for a book as above, if you want them for painting figures. All colours are laid on twice in books, at first very thinly, then more thickly; but once for letters."

The use of Spanish green (verdigris), though fugitive in water-colours when exposed to light, seems to be justified for illuminating books, judging by the magnificent preservation of the greens in many old illuminated manuscripts.

In chapter xxxv. the tempering of "folium," which seems to have been a preparation of more than one vegetal dye, is described:—

"CHAPTER XXXV

"*Of the kinds and the tempering of Folium*

"There are three kinds of folium, one red, another purple, a third blue, which you will thus temper. Take ashes, and sift them through a cloth, and sprinkling them with cold water, make rolls of them in form of loaves, and placing them in the fire, leave them until they quite glow. After they have first burnt for a very long time and have afterwards cooled, place a portion of them in a vessel of clay, pouring urine upon them and stirring with wood.

When it has deposed in a clear manner, pour it upon the third folium, and grinding it slightly upon a stone, add to it a fourth part of quicklime, and when it shall be ground and sufficiently moistened, strain it through a cloth, and paint with a pencil where you wish, thinly, afterwards more thickly. And if you wish to imitate a robe in a page of a book, with purple folium; with the same tempering, without the mixture of lime, paint first with a pen in the same page, flourishes or circles, and in them birds or beasts, or leaves; and when it is dry, paint red folium over all, thinly, then more thickly, and a third time if necessary; and afterwards paint over it some old clear of egg, beat up without water. Do not grind purple or blue folium, but pour it with the same tempering, without lime, into a shell, and stir it with wood, and when it has stood for a night, the next day use it in what manner you wish, paint over it with clear of egg. Paint over also with glaire of egg, draperies, and all things which you have painted with folium and carmine. You can likewise preserve the burned ashes which remain, for a long time, dry."

Preparations of this kind are often referred to, and seem to have been obtained as follows:—An extract

of the vegetal dye having been prepared, a piece of linen was alternately soaked in the dye and in alum. In this way the dye was loosely mordanted on to the linen, but could be easily extracted with an alkaline solution. Such transparent vegetal pigments must have been very fugitive, and have probably perished, at any rate wherever exposed to light. "Folium" itself seems to have been more strictly the juice of the *Croton tinctorium*, which would change in colour according as the medium was acid or alkaline.

Then follow receipts for making "salt-green," a mixture of verdigris and subchloride of copper, of Spanish green or verdigris, of cinnabar or vermilion, of ceruse (white lead) and minium (red lead), all of which receipts agree with the methods of to-day.

Finally, in chapter xl. the preparation of ink is described. The ink of classical times was, we have seen, lampblack ground up with gum arabic and water; the ink of Theophilus is the modern ink, that is, an infusion of tannin and sulphate of iron or green vitriol. It will be noted that in the opening chapters nothing is said of the medium to be used; but in the course of the narrative, mediums of yolk of egg, white of egg, fish-glue, parchment, cherry and plum-

tree gum, and linseed oil are mentioned, each, however, for a more or less specific purpose, and leaving it open to question whether egg was not the ordinary recognised medium if none other were mentioned.

No mention is made of the classical medium, wax, except for another purpose, so that its use must have completely died out between the time of the Lucca MS. and Theophilus.

This early and free use of linseed oil (though evidently found somewhat slow in drying) is conclusive as to the early discovery of oil-painting at any rate in the North.

There is no receipt for the preparation of ultramarine from lapis lazuli, the commonplace of later manuscripts.

CHAPTER X

THE BOOK OF THE ART, BY CENNINO CENNINI

In the last chapter we have considered in some detail the MS. left by the monk Theophilus of the eleventh century, and his receipts and descriptions of how to prepare for painting. Those who are interested in the instructions given for mixing various tints for flesh, and in the books on glass and working in metals, must consult the original, as both are beyond our province. Nor is there space here to discuss various interesting manuscripts of somewhat later date, such as the Paris MS., translated by Mrs Merrifield, and originally brought together by one Le Bègue in the fourteenth century. Quotations from these manuscripts and others will necessarily be made in considering the methods of oil-painting, the receipts for varnishes and the receipts for lakes; but we cannot break the main course of our narrative to consider them further here, as we must pro-

ceed to deal with the treatise on tempera painting left by Cennino Cennini. The formal painting and sculpture, due to the Byzantine traditions, had begun to alter in the thirteenth century, starting with a revival of sculpture in the hands of Niccolo Pisano, of which his pulpit at Pisa (1260) is an example. The first examples we possess of the revival in painting are the *Last Judgment* at St Cecilia in Rome by Pietro Cavallini (1293), and the *Madonna* at Siena by Duccio di Buoninsegna (1255–1315). In Florence the new movement was begun by Cimabue, who was the teacher of Giotto (1266–1337), the founder of the Florentine school.

These artists were all painters in "tempera," that is to say, the medium with which their colours were blended was egg in one form or another; and from the universality of the use of that medium the phrase "tempera" painters has come to mean painters with an egg medium, although the word is applied by the early Italian writers to any medium—oil, egg, gum, or glue—they may be discussing. This great school of tempera painters continued through the fourteenth and fifteenth centuries, finally giving place to the oil medium, which is supposed to have been introduced from Flanders, and culminating

in the painting of such masters of tempera as Sandro Botticelli (1447–1510) and Fra Filippo Lippi (1406–1469).

The Annunciation, by Fra Filippo Lippi, in our National Gallery, probably represents the final perfection possible in the medium. In fact, Eastlake, the author of *Some Materials for a History of Oil-Painting*, did not believe that it was a tempera picture, suspecting some additions to the medium to make such technique possible. Mrs Herringham, on the other hand, who has now practised tempera-painting for many years, regards it as a perfect example of what tempera-painting can do.

The two tempera pictures chosen here for reproduction have been taken because they illustrate with great perfection the preservation of brilliant colouring in this medium. The painter of one is unknown. Benozzo Gozzoli, the painter of the other, was born in 1420, and died in 1498. He therefore belongs to the period when the finest work in tempera was being executed, and was himself a pupil of Fra Angelico da Fiesole, and executed many delightful works in fresco. The picture here selected for reproduction is *The Rape of Helen*, and is in our National Gallery. It is painted on wood, probably the end or cover of a box or cassettone such as were used for wedding gifts,

and is in an excellent state of preservation. The perfection with which the brilliant unglazed vermilion has been preserved is especially worthy of note, as vermilion has been among the suspected pigments since classical times, when, as we have seen, both Pliny and Vitruvius warn us against exposing vermilion to the sun.

To return, however, to our subject. Cennino Cennini was, as he tells us, instructed in the art of painting for twelve years by Agnolo Gaddi, the son of Taddeo Gaddi, the godson and pupil of Giotto. He was living in Padua in 1398, while his master, Agnolo Gaddi, died in 1396.

The Vatican MS. of Cennino Cennini is dated 1437, but this is probably the date attached by the copyist, who seems to have done his work in the debtors' prison at Florence, so it was probably written before this date. The treatise, therefore, can be considered as summing up, on the one hand, the teaching in painting of the fourteenth century and founding the methods of the fifteenth century, so that it gives us a detailed insight into the way the great school of tempera painters did their work. In addition, it informs us of other methods of painting, and the information it contains about fresco-painting has already been quoted. Of Cennino Cennini himself little

is known. Vasari refers to him among the minor painters, but more because of his treatise than because of his work. Vasari tells us "that Cennino di Drea Cennini of Colle-di-Valdelsa learned painting from this same Agnolo (Agnolo Gaddi), and for love of his art he wrote with his own hand on the methods of painting in fresco, in tempera, in size, and in gum, and besides how to paint in miniature, and how gold is laid on for all these different kinds of painting, which book is in the hands of Giuliano, a Sienese goldsmith, an excellent master, and a friend of these arts."

No picture known to be by Cennino Cennini is in existence, and consequently his fame rests upon his treatise and not upon the actual work of his hand. But his treatise is not only of technical interest on account of his receipts and directions how to draw and to paint; it is also of the greatest value as the unconscious, unpremeditated revelation of the character and point of view of the man who wrote it, and consequently of the influence upon him of the environment in which he lived. The preface to the third book of Theophilus is in itself a revelation of the point of view of an eleventh-century monk, but after all it is an exhortation addressed to the reader, and therefore necessarily has in it a certain artificial

quality and tells us little of the man himself; while, to go to a later time than the one we are considering, the autobiography of Benvenuto Cellini is a most naive and therefore precious revelation of a robust blackguard of the Italian Renaissance, who, however, still retains a deep ethical purpose in his work as a craftsman; but here, too, we are dealing with autobiography which at once involves a certain self-conscious pose of the author before the public. We are still looking for the honest diary or correspondence of a man of genius which was not written with an eye on posterity and the future publisher. In this treatise by Cennino Cennini we have the writer inspired simply by the desire to give information about his craft, and therefore his way of giving that information is a purely unconscious revelation of his personality and point of view. It is impossible by a few quotations to convey fully to the reader the delicate flavour of this treatise. While reading it we seem to be removed to a sunny but simply and yet beautifully furnished house, where our artist sits at work in a room with only the severest necessaries of his craft around him, and the symbols of his religion. Here we see him full of a childlike piety, and engaged in exquisite and dainty manipulation, tinting a sheet of vellum, or laying gold leaf on a panel with a

pleasure in the perfect product and a joy in its finished beauty.

The very dedication of the book sets the keynote to the whole: "Here begins the book of the Art, made and composed by Cennino da Colle in the reverence of God and of the Virgin Mary, and of St Eustachius, and of St Francis, and of St John the Baptist, and St Anthony of Padua, and generally of all the saints of God, and in the reverence of Giotto, of Taddeo, and of Agnolo the master of Cennino, and for the utility and good and advantage of those who would attain perfection in the Art."

The very titles of the chapters have a perfume about them like the scent of lavender, and the daintiness of an exquisitely bound book. For instance, to select at random: "How a green tint is made on drawing-paper and how it is tempered," "How to tint parchment and how to burnish it," "How to tint paper of a morella or purple colour," "In what manner you make an outline of a beautiful face or design on transparent paper," "In what manner this tin overlaid with gold can be used for the diadems of saints on walls," "How works in relief are executed on panels with gesso sottile, and how precious stones are affixed to them," are among the headings of chapters. But it is perhaps still more in the simple

piety and quaint moralisings in the receipts themselves that the most is to be found. To take this, for instance :—

"*How you should regulate your manner of living so as to preserve decorum, and keep your hand in proper condition ; and what company you should frequent ; and how to select and draw a figure in relief*

"Your manner of living should always be regulated as if you were studying theology, philosophy, or any other science ; that is to say, eating and drinking temperately at least twice a day, using light and good food and but little wine, sparing and reserving your hand, saving it from fatigue, as throwing stones or iron bars, and many other things which are injurious to the hand, wearying it. There is still another cause the occurrence of which may render your hand so unsteady that it will tremble and flutter more than leaves shaken by the wind, and this is frequenting too much the company of ladies. Let us return to our subject. Make a pocket of sheets of paper glued together, or of light wood, square shaped, large enough to hold a foglio reale—that is, half size, and also serve for a desk to draw on. Then always retire alone, or with companions who are inclined to do as you do, and are not disposed to hinder your work ; and the more intellectual the

companions are, the better will it be for you. When you are in churches or chapels and you begin to draw, consider first what space or history or figures you wish to sketch, and remark where the shades, middle tints, and lights fall; and I must tell you how to shade with ink and water, to leave the ground of the panel for middle tints, and to use white for the lights."

Or take the following from the introductory chapter:—

"A humble member, then, of the art of painting, I, Cennino, born of Drea Cennino of the Colle-di-Valdelsa, was instructed in these arts for twelve years by Agnolo, the son of Taddeo of Florence, my master, who learnt the art from Taddeo his father, who was the godson of Giotto, and was his disciple for twenty-four years.

"This Giotto changed the art of painting from the Greek to the Latin, and brought it to the modern style; and he possessed more perfect art than ever anyone else had had. In order to assist all those who would approach this art, I shall take note of all that was taught me by my master Agnolo, and of that which I have proved by my own hand; invoking first the high Omnipotent God—that is to say,

the Father, Son, and Holy Spirit; secondly, that most delightful advocate of all sinners, the Virgin Mary, and St Luke the Evangelist, the first Christian painter, and my advocate, St Eustachius, and generally all the saints, male and female, of Paradise."

Or take the following from the receipt for preparing ultramarine from lapis lazuli, which we shall presently quote in full:—

First the blue is described: "Ultramarine blue is a colour noble, beautiful, and perfect beyond all other colours, and there is nothing that could be said of it, but it will still exceed this praise."

Then, after a long description of the complex and difficult mode of preparation, we have:—

"When dry, put it into a skin or purse and rejoice in it, for it is perfect; and bear in mind that it is a rare gift to know how to make it well. You must know also that it is rather the art of maidens than of men to make it, because they remain continually in the house, and are more patient, and their hands are more delicate. But beware of old women."

Or take the following chapter:—

"*Showing that you should always make a habit of working with fine gold and good colours*

"It is usual to adorn walls with gilded tin, because it is less expensive than gold. Nevertheless, I give

you this advice, that you endeavour to adorn always with fine gold and good colours, particularly in the figures of our Lady.

"And if you say that a poor person cannot afford the expense, I augur that if you work well and give time to your work and good colours, you will acquire so much fame that a rich person will come to you to pay for the poor one ; and your name will stand so high for using good colours, that if some masters receive one ducat for painting a figure, you will be offered two, and your wishes be fulfilled, according to the old proverb—good work, good pay. And whenever you should not be well paid, Godand our Lady will reward you soul and body for it."

Or again, after telling us how to paint the human face, he tells us in the next chapter,

" Why women should abstain from using medicated waters on their skin

"It might happen in the service of youthful ladies, especially those of Tuscany, to have to make some colour of which they are desirous, and use to make themselves beautiful, and certain waters.

"But the Paduan women do not use them, and, not to give them cause for finding fault with me, and as it is also displeasing to God and our Lady, I shall

be silent. But I advise you, if you desire to preserve your complexion for a long period, to be accustomed to wash yourself with water from fountains, rivers, or wells; and I warn you that if you use any artificial preparation your face will soon become withered, and your teeth black, and in the end women get old before the natural course of time and become the ugliest old hags possible. This is quite sufficient to say on this subject."

I have already quoted the opening sentences of the treatise, and it only remains to quote the conclusion, before proceeding to consider it in its purely technical aspect.

This conclusion is as follows :—

" Praying that the Most High God, our Lady, St John, St Luke the evangelist and painter, St Eustachius, St Francis, and St Anthony of Padua may give us grace and strength to sustain and bear in peace the burdens and fatigues of this world; and that to whomsoever may study this book, they will give grace to study it well and remember it, so that by the sweat of their brow they may live peaceably, and maintain their families in this world with grace, and finally, in that which is to come, in glory, *per infinita secula seculorum.*"

We shall now proceed to deal with the technical information to be obtained from Cennino Cennini, and begin by considering his directions for the preparation of panels.

In preparing a panel for painting, it is essential that the wood should not warp or crack, and that the layer of plaster or gesso on the panel should not be liable to crack off. We accordingly find special precautions taken to guard against these dangers. Probably the best guard against cracking and warping is to have *thoroughly* seasoned wood. This is not easy to secure, unless the wood has been stored by yourself. But there is another precaution for small panels, given by Cennino Cennini, which is interesting. He advises *boiling* them in water, to prevent warping or cracking. I have made some inquiries into this, and I find that it corresponds somewhat with a modern practice, namely, the steaming of wood to get it seasoned rapidly. I do not find, however, that this practice is regarded as the best by carpenters. They consider that slow air drying is the best. Apparently, the most important matter is to season the panel after it is cut to its final shape and size. The panel should be cut in summer, and kept to next summer. If this is done, some will warp, twist, and crack, and may be rejected; others

will survive the test, and are then safe. The careful selection and seasoning of the wood is of the first importance. Cennino says little about it. He, probably, trusted to his carpenter to see to that for him.

Having now obtained a piece of wood of suitable size and shape, we must next prepare it with a fine surface of gesso, on which the picture is to be painted. Obviously, the important point now is to prevent the possibility of the gesso peeling off. This can best be prevented by thoroughly roughening the surface of the wood, so as to give a tooth on which the fine plaster can hold, just as a plasterer marks his rough lime with the trowel, in order to enable the fine lime finishing the wall or ceiling to firmly adhere. This, then, being the most important matter, you will not be surprised to hear that the intelligent maker of panels for painting at the present day carefully smooths his wood before laying on the gesso.

Before quoting in full, as I propose to do, Cennino Cennini on this matter of panel preparation, I shall briefly refer again to the method used by the Egyptians in certain cases. The wooden coffin lids were prepared for painting on by being first coated with gesso, and it was my good fortune to be presented

with a small crumb of such a coating by Professor Middleton, obtained from a coffin in the British Museum. There was a streak of green pigment on this fragment, which has already been described; but with that we have nothing to do at present.

On examining this portion of prepared surface, I found a thin coating of fine white plaster lying over a dark brown substance, resembling oil-cake in appearance.

I was somewhat troubled to make out what this substance could possibly be. It seemed about one-sixteenth inch thick, and must have lain between the white plaster and the surface of the wood. On moistening the fragment with hot water it fell to pieces, the binding cement or gum being dissolved, and then, on examining under a glass, the nature of this substance was revealed. It consisted of grains of sand mixed with wood fibres.

The way in which the panel had been prepared was now sufficiently obvious. The surface of the wood had been rubbed and torn up with sand mixed with gum water. Then the whole surface had been smoothed down, sand, wood fibres, and all, and allowed to harden. Then on this curious concrete, bound to the wood by partially torn fibres, the fine white gesso had been laid. The revival of this

method is worthy of careful consideration, and I can safely recommend it. It has stood the test of more than 3000 years. Passing, then, from this ingenious method, let us consider how Cennino Cennini mastered the same difficulties.

I cannot do better than quote directly from his work :—

"CHAPTER CXIII

"*How to begin to paint pictures*

"Now we are really going to paint pictures. In the first place, a panel of the wood of the poplar, lime, or willow tree must be prepared, on which to paint the picture. Let it be made quite smooth. If it be defaced with knots, or if it be greasy, you must cut it away as far as the grease extends, for there is no other remedy. The wood must be very dry; and if it be such a piece that you can boil in a cauldron of clean water, after the boiling it will never split. Let us now return to the knots, or any other defect in the smoothness of the panel.

"Take some glue [*colla di spicchi*], and about a glassful of clean water; melt and boil two pieces [*spicchi*] in a pipkin free from grease; then put in a porringer some sawdust, and knead it into the glue; fill up the defects or knots with a wooden spatula, and let them remain; then scrape them

with the point of a knife till they are level with the rest of the panel. Examine if there be any nail, or other thing that renders the panel uneven, and knock it into the panel, then provide some pieces of tin-plate, like *quattrini* [small pieces of money], and cover over the iron with them ; and this is done that the rust of the iron may not rise through the ground. The surface of the panel must not be too smooth. Boil some glue, made of parchment shavings, till the water be reduced to one-third of what it was at first, and, when put on the hands, if one hand stick to the other, it is sufficiently boiled. Strain it two or three times, put half this glue into a pipkin, add a third part water, and boil well together ; then, with a hog's-hair pencil, large and soft, pass a coat of the glue over the panel, or foliage, or pyxes [*civori*], or columns, or whatever you work upon, that is to be covered with a ground [*ingessare*], and let it dry ; then take some of your first strong glue [*colla forte*], and pass twice over your work, letting it dry well between each coat of glue, and it will be glued to perfection.

" Do you know the effect of the first glue ? A weak water or liquor is absorbed from it by the wood, which operates exactly as if, when fasting, you eat a few comfits, and drank a glass of wine, which gives

you an appetite for dinner; so this glue prepares the wood for the glue and grounds to be applied afterwards.

"CHAPTER CXIV

"*How to fasten linen on panels*

"Having thus spread the glue, get some linen cloth, old, fine, and white, and free from grease. Take your best glue, cut or tear this linen into large or small strips, soak these in the glue, and spread it with your hand over the surface of the panel; remove the seams, and spread it well with the palms of the hands, and leave it to dry for two days. And remember it is best to use glue when the weather is dry and windy. Glue is stronger in the winter. For gilding, the weather should be damp and rainy.

"CHAPTER CXV

"*How to lay grounds of gesso grosso on the surface of a picture with a spatula*

"Where the panel is very dry, take the point of a knife like a rasp [*mello*], rasp it well, and make the surface quite even. Then take some gesso grosso, that is to say, volterrano, purified, and sifted like flour. Put a porringer-full on the porphyry slab, grind it well with this glue, as you would grind

colours, collect it, and put it on the surface of the pictures, and, with a very smooth and rather large spatula, cover the whole surface, and wherever you can use the spatula do so.

"Then take some of this ground plaster (gesso), warm it, take a soft hog's-hair pencil, and give a coat on the cornices and foliage, and on the even surfaces with the spatula. Give three or four coats on the other parts of the cornices, but on the other level parts you cannot use too much. Leave it to dry for two or three days. Then take the iron rasp [*mesella*], and level the surface; procure some small iron rods, which are called raffiette, such as you will find in the painters', who use several kinds of them. Pick out all the cornices and foliage which are not flat, and with these make every part of the surface of the ground smooth and free from knots.

"CHAPTER CXVI

"*How to prepare a fine ground (gesso sottile) for pictures*

"You must now prepare a plaster of fine grounds, called gesso sottile. This is made from the same plaster as the last, but it must be well washed [*purgata*], and kept moist in a large tub for at least a month; stir it up well every day until it almost rots

[*marcise*], and is completely slaked, and it will become as soft as silk. Throw away the water, make it into cakes, and let it dry; and this plaster [*gesso*] is sold by the apothecaries to our painters. It is used for grounds for gilding, for working in relief, and other fine works.

"CHAPTER CXVII

"*How to prepare a ground of gesso sottile on a picture, and how it is to be tempered*

"Having laid on the gesso grosso, rubbed down the surface, and levelled it well and delicately, put some cakes of the gesso sottile into a pipkin of water, and let them absorb as much as they will. Put a small portion of it at a time on the porphyry slab, and, without adding any more water to it, grind it perfectly. Put it then on a piece of linen cloth, strong and white, and wring it well to get out as much water as possible. When you have ground as much of it as you want (that you may neither have to make two portions of tempered plaster, nor to throw away any good plaster), take some of the same glue with which you tempered the gesso grosso. You must make sufficient at one time to temper both kinds of gesso. The gesso sottile requires less tempering than the gesso grosso;

the reason for this is that the gesso grosso is the foundation of all your work, and that how much soever you press the gesso grosso a little water will still remain in it. For this reason make the same kind of glue for both. Take a new pipkin which is free from grease, and if it be glazed, so much the better. Take a cake of this gesso sottile, and scrape it fine with a knife, as you would cheese, and put it into the pipkin. Put some of the glue on it, and work the gesso with the hand as you would a paste for making fritters, smoothly and evenly, so that it may not froth. Procure a cauldron of water, and make it very hot, and put into it the pipkin containing the tempered gesso. Thus the gesso will become warm, but will not boil; for if it should boil, it would be spoiled. When it is warm, take your picture, and a large and very soft pencil of hog's bristles, dipped in the pipkin, and taking up a proper quantity at a time, neither too much nor too little, spread it evenly over the level surfaces, the cornices, and the foliage. It is true that in doing this the first time you should spread and rub the gesso with your fingers, and hand, round and round, and this will incorporate the gesso grosso with the gesso sottile. When you have done this, begin again, and spread it with a brush, without touching it with the hand.

Let it rest a little, but not so long as to dry thoroughly; then go over it again in the other direction with the brush, and let it dry as usual. Then give it a coat in the reverse direction; and in this manner always keeping the gesso warm, give the panel eight coats. Foliage and *relievos* want less, but you cannot put too much on the flat. This is on account of the rasping down, which is done afterwards.

"Chapter CXX

"How to begin to smooth the surface of a panel on which you have laid a ground of 'gesso sottile'

"When you have finished laying the ground (which must be done in one day, even if you work at it in the night, in order to complete it in the usual way), let it dry in the shade for two days and nights at least. The drier it is the better.

"Tie some powdered charcoal in a piece of linen, and sift it over the ground of the picture. Then, with the feather of a hen or goose, spread this black powder equally over the ground, because the panel cannot be made too smooth, and because the iron with which you rub the picture is smooth also. When you remove it, the ground will be as white as milk, and you will then see whether it requires more rubbing with the iron.

"CHAPTER CXXI

"*How to scrape surfaces on which 'gesso sottile' has been laid, and of what use the scraping is*

"Take a flat raffietto, about as wide as a finger, and gently rub the surface of the cornice once; then, with a sharp rasp [*mella arrotata*], which you must hold as freely and lightly as you possibly can, rub over the surface of the panel with a very light hand, brushing away the loose gesso with the feather. And know that this dust is excellent for removing grease from the pages of books [*carte de libri*].

"In the same manner rub smooth the cornices and foliage, and polish them as if they were ivory. And sometimes (for you may have many kinds of work) you may polish cornices and foliage by rubbing them with a piece of linen, first wetted and then squeezed almost dry."

The bands of old linen evidently serve the purpose of the sand in the Egyptian method. They afford a tooth for the plaster, and at the same time must help to hold the panel together, and also help to prevent resin rising through the gesso surface. Apparently linen was also used for the best coffins in Egypt in the same way.

The gesso volterrano is, according to Mrs Mer-

rifield, plaster of Paris, which was obtained from some gypsum quarries in the neighbourhood of Bologna, and Vasari gives a long account of this gesso volterrano in his life of Andrea Verrocchio, who used it to make casts of dead persons.

It will be noted that the gypsum for the final coating of gesso is thoroughly slaked by keeping in water for some weeks.

A very fine example of gesso work exists in the old cathedral church at Coire. They have there a box which they claim to be as old as the ninth century. It is entirely covered with gesso, on which a design in low relief has been roughly scrolled. The gesso has been polished so as to give the appearance of ivory. At the corners, where it has got chipped off, the ends of the linen can be seen, which has evidently been put next the wood, as Cennino Cennini advises. There is nothing, I think, in the whole of this account which could not be easily reproduced at the present day. I have had mahogany panels carefully prepared by a picture-frame maker, from Cennino's directions.

Gilding

Having completed the preparation of the panel, we can now paint upon it, or, as was usually done

in the earlier Italian pictures, cover it completely with gold leaf.

For this purpose Cennino Cennini mentions three mordants that can be used: one prepared from white of egg and Armenian bole, one a quick-drying oil-varnish similar to the gold size now used, and one prepared from garlic juice. He devotes some space to the account of gilding done with the white of egg medium, which I shall quote in full. The only trace of this method of gilding left now is the use of white of egg by bookbinders in gilding books. The bole is used in water-gilding now with parchment glue.

"CHAPTER CXXXI

"*How to lay bole on panels, and how to temper it* (1)

"Let us return to our subject. When you have finished the relievos of your picture, procure some Armenian bole and try whether it be good. Touch your under lip with it; if it stick to it, it is good. You must now learn the best tempera for gilding. Put the white of an egg into a very clean glazed porringer. Make some twigs of broom into a rod, and beat up the white of egg with it until the porringer is full of thick froth, which appears like snow. Then take a common drinking-glass, not too large nor too full of water, pour it on the white of egg into

the porringer. Let it stand from night till the next morning, to clarify itself. Then grind the bole in this tempera as perfectly as you can. Next dip a clean soft sponge into clean water, and squeeze it dry; rub lightly with the sponge (not too wet) on these parts on which the gold is to be laid. Then pass over it, for the first time, with a large pencil of minever, a coat of this tempered bole as liquid as water, and, wherever the gold is to be used (having first sponged the part with water), spread the bole very evenly, being careful not to stop, so that you may leave no hard edges with your pencil. Then wait a little; put a little more bole into your porringer, and let the second coat of colour have a little more body. Give it this second coat, and let it again rest a short time; put more bole into the vase, and give it a third coat in the same manner, making no hard edges. Put more bole still in the vase, and give it a fourth coat, and then you will have finished laying on the bole. Now you may cover over your panel with a cloth, to keep it as much as you can from dust, sun, and water.

"CHAPTER CXXXIV

"*How to gild panels*

"When the weather becomes damp and cloudy, and you wish to lay on any gold, place your panel

flat on two trestles. Sweep it with a feather, and, with a raffietto, pass very lightly over the ground of bole, and if you find any knots or roughness remove them. Burnish the bole very carefully with a piece of coarse linen. If you afterwards burnish it with a tooth, it cannot look otherwise than well. When you have thus cleaned and burnished it, put into a glass nearly full of clean water a little of the white of egg tempera; if it be quite fresh so much the better. Mix it thoroughly with the water. Take a large pencil of minever, made, as I have previously taught you, of the hairs of the tip of the tail. Take up your fine gold with a pair of fine pincers, lay it on a square piece of card larger than the piece of gold, and cut off at each corner, which you are to hold in your left hand, and, with the pencil which you hold in your right hand, wet the bole sufficiently to hold the piece of gold you have in your hand. Wet the bole equally, that there may not be more water on one part than on another; then let the gold slip off the card, taking care not to wet the card. Now, as soon as the gold has touched the wet part, withdraw the card quickly and suddenly; and if you perceive that the gold does not adhere to the panel, press it down as gently as you can with a piece of clean cotton, and in this manner gild the other parts

of the panel; and when you wet it, preparatory to laying on the second piece of gold, be careful that the pencil does not go so near the first piece as to make it wet; and let the two pieces join, first breathing on it, that the gold may adhere where you wish it to unite with the other piece. When you have laid on three pieces, pass the cotton again over the first piece, and see whether any part requires mending. Provide a cushion as large as a brick, made of a smooth piece of board, covered with soft leather, very clean and not greasy, of the same kind as that of which boots are made. Stretch it very evenly, and fill the space between the wood and the leather with shreds of cloth; spread a piece of gold evenly on this cushion, and with a knife cut the gold into pieces as you want it, to make the necessary repairs. Wet the parts to be repaired with a minever pencil, and, then, wetting the handle of the pencil with your lips, the piece of gold will adhere to it sufficiently to enable you to apply it on the part to be mended. When you have laid as much gold on the level surface as you can burnish in one day (for which I shall give you directions when you have to gild cornices and foliage), be careful to collect the small pieces of gold, as those masters do who are economical, so that you may save the gold as much as you can, be-

ing sparing of it, and always covering the gold you have laid on with a clean handkerchief.

"CHAPTER CXXXV

"What stones are proper for burnishing gold

"When you mean to burnish gold, you must procure a stone called lapis amatisto, which I will show you how to prepare. If you have not this stone, sapphires, emeralds, balas rubies, topazes, rubies, and garnets are still better for those who can afford the expense, and the finer the stone the better it is for the purpose. The teeth of dogs, lions, wolves, cats, leopards, and generally of all carnivorous animals, are equally good.

"CHAPTER CXXXVII

"How to burnish gold, and what to do if you cannot burnish it when ready for burnishing

"You must now burnish gold; for the time is come that you should do so. It is true that, in winter, you may gild whenever you please, during damp and cloudy weather. In summer it will take one hour to lay on the gold; another to burnish it; but should the weather be too damp, and, from some cause or other, you want to burnish it, keep it in a place where it is not exposed to heat and air; but if it be too

dry, keep it in a damp place, always covered, and, when you would burnish it, uncover it carefully, for the smallest scratch will blemish it. Put it in a cellar, at the foot of the casks, and it will be ready to burnish ; but should you be prevented from burnishing it for eight or ten days or a month, take a very clean handkerchief or a towel, lay it over your gold in the cellar, or wherever it may be ; then take another handkerchief, dip it in clean water, wring, and squeeze it very dry ; open it, and spread over the first handkerchief that you laid over the gold, and the gold will then be in a proper state for burnishing."

We have here a complete account of gilding with white of egg. Further on, he gives the following receipt for another mordant :—

"A perfect mordant for walls, pictures, glass, iron, and ever other thing may be made as follows : With your oil either boiled on the fire or baked in the sun in the manner before directed, grind a little biacca (white lead) and verdigris ; and when you have made it flow like water, add a little varnish and boil altogether for a short time."

The varnish mentioned here is probably an oil varnish, as the varnishes described at that time are all oil varnishes. The verdigris would make it dry

very quickly, and, consequently, he directs later on that no verdigris is to be added if it is not to be used at once. He also states that some fear the verdigris injuring the gold, but he has not found it do so. The rest of the directions are the same as those now given for gilding. It is of interest to note that, though he especially says the leaf must be thick for the white-of-egg gilding, he recommends very thin leaf for this gilding.

For miniature work he recommends the use of a little gesso sottile (one-third) mixed with a little white lead and sugar of "candia." This is made into cakes and dried in the shade. This is ground with white of egg for use. "And you must know that you may write letters with a pen dipped in this size." In another receipt he adds also a little Armenian bole.

The late Professor Middleton had an illuminated MS. of the sixteenth century, in some parts of which the gold had come off. Underneath is a hard polished substance raised above the level of the parchment. Apparently in this case Armenian bole had been used. Besides gold leaf, silver leaf and tin leaf were used. Tin leaf is recommended as superior to silver leaf, as it does not blacken. Cennino Cennini recommends the use of the tin leaf for glories of saints

in wall-paintings. His directions are a little obscure, but apparently it is stuck on with varnish. He also recommends gilding it before sticking it on.

This use of tinfoil is of special interest. At a later date it seems to have been used largely instead of gold, being coated with a yellow varnish called auripetrum. Several receipts for auripetrums are given in the old MSS. The Spanish leather hangings which are so famous have been prepared this way. I have examined some portions of some old hangings in the possession of the late Mr Cobbold, of Felixstowe. A design had been stamped on the leather, then it had been covered with tin leaf. Some parts of the tin leaf had been varnished with a yellow varnish and other parts painted, the rich bronze gold colour being so produced. As an experiment I have coated canvas with size, then with gold size, and then with tinfoil. The tinfoil has then been polished and varnished with an oil varnish coloured with dragon's-blood.

The receipts for the preparation of auripetrum are somewhat obscure. Several are given in the MS. of St Audemar, which has been translated by Mrs Merrifield. In these the oil varnish used is coloured by saffron, aloes, the inner bark of black plum, or dragon's-blood. These substances are all easily dis-

solved in melted pine balsam, which can then be diluted with boiled oil and turps.

The reintroduction of varnished tinfoil for decorative work is, I think, to be recommended. Very beautiful and durable results are, I think, easily obtained.

Dragon's-blood is easily obtainable, but varies very much in quality ; the best that can be *now* obtained being sent over in sticks about eight inches long, each stick being encased in some native fibre. The dragon's-blood in lump, as usually sold, is very inferior. The dragon's-tears referred to by Charles Reade, in his essay on violins, are unfortunately no longer to be had. I once knew of one sample, in a herbalist's window in East London, and it was not for sale.

There is no great difficulty in having panels prepared for painting according to the method herein described, as the practices of the best gilders approach very closely to Cennino Cennini's receipts. It is perhaps not generally known that gold leaf is translucent, and that the light passing through is blue-green in colour. The laying of gold on white gesso on the ground for the picture must, I think, have had an important effect on pigments above it, corresponding to a green ground to a certain extent.

It must, however, be remembered that many pictures were painted directly on the white gesso ground without the interposition of gold leaf.

We have now dealt with the preparation of panels for painting, with gilding, and with the use of tinfoil and coloured varnishes. The receipts are similar to those at present in use, and if equally good and durable results are not obtained it seems to be due more to want of care and of taking time than to serious defects of method. We come next to the consideration of the pigments used during the best period of art, with the view of carefully examining their nature and properties. Here we are met by several difficulties.

In the first place, we are embarrassed by the number and variety of pigments mentioned. I cannot attempt to deal with more than a few of them in this chapter, and must select those of apparently the most importance. In the next place, it is in many cases difficult to identify an old pigment, or to recognise the same pigment under different names. Much ingenuity, however, has been expended on this subject, and, on the whole, with tolerably satisfactory results.

In the third place, a large proportion of the old pigments are fugitive, and we are consequently some-

what embarrassed by this fact, as it throws upon us the burden of picking out those of real value from among the many described.

It is of importance, in this connection, to remember the various uses to which the pigments were put. Roughly, these may be described as: painting in fresco, painting in secco on walls, painting in secco on panels, painting in oil, and illuminating MSS.

Now, of these, the most destructive to pigments is fresco-painting, and consequently few pigments could with safety be used, while, on the other hand, many pigments might safely be used for illuminating that could not be used for anything else. Protected from damp and from the action of light, preserved between closed leaves of vellum, and probably never touched by sunlight, many fugitive pigments might be safely used.

It is, furthermore, impossible to consider this subject of the durability of pigments by itself, apart from the mediums used to paint with. When we come to consider the question of vehicles, we shall find that certain pigments may safely be used with some vehicles that cannot be used with others. There is another very pertinent question that can be asked: How many of the old works of art have perished completely from natural decay? Are not those we

possess the successful experiments among many failures? It is a common remark to say of an old master that it is as fresh as the day it was painted. There are very few that really have this appearance. If carefully examined, the colours have, in many cases, dulled and faded. The pigments still look bright owing to their contrast one with another, though often, when examined separately, they appear quite dull.

Unfortunately, too, there are pigments which, while quite legitimate under old conditions, are no longer suitable for use in the polluted air of modern cities. It is also of importance to consider climatic conditions in this connection. For instance, it is an easy problem to paint permanent pictures in the dry climate of Egypt, a very difficult one to do the same in England. All these matters have to be taken into consideration, giving us a very complex problem to be dealt with.

Let us begin by considering the list of pigments mentioned by Cennino Cennini. This list we can add to afterwards, but it forms an important and useful introduction. They are as follows :—

Red.—Sinopia (red ochre), cinabrese (red ochre and white), cinnabar, minium, amatisto (hæmatite), dragon's-blood, lake.

Yellow.—Ochre, giallorino (Naples yellow), orpiment, risalgallo (realgar), zafferano (saffron), arzica.

Green.—Verde terra, verde azzurro (copper green, malachite), verderame (verdigris).

White.—(Chalk) bianco sangiovanni, (white lead) biacca.

Blue.—Azzurro della magna (azurite), azzurro oltre marino (ultramarine).

Black.—A soft black stone. Black made of the tendrils of young shoots of the vine. Black made of the skins of almonds, or the kernels of peaches. Lampblack.

Let us take these pigments in order, and consider them one by one.

Sinopia.—This is one of the many names under which red ochres are mentioned, whether native or prepared by roasting yellow ochres. They have been used from the earliest times, and are perfectly reliable for all kinds of work. There is no need to dwell longer on them.

Cinabrese.—This pigment is described by Cennino as being a mixture of red ochre with chalk. This is very commonly done now in order to prepare a bright red, and is a perfectly harmless practice.

Cinnabar (*vermilion*).—This pigment is known in two forms, native and artificial. Cinnabar, or sulphide of mercury, is one of the commonest ores of that metal, and is occasionally found in pieces of a fine red colour when ground. Probably it was first used in this form. A much finer pigment is, however, obtained by subliming sulphur and mercury in a covered crucible, when the cinnabar is found at the top in crystalline masses. This method of preparation must have been known from very early times.

The preparation of mercury is described by Theophrastus, 300 B.C., and the early alchemists, such as Geber, were familiar with many of the compounds of mercury, so that there can be little doubt that they were also familiar with the artificial preparation of vermilion.

The oldest of the MSS. on the preparation of pigments, that at Lucca, supposed to be of the eighth century, describes the preparation of artificial vermilion; and similar receipts occur repeatedly in MSS. of later dates. Returning again to Cennino, there can be no doubt that the vermilion he refers to is artificial. He says: "This colour is produced by alchemy, performed in an alembic. . . . You may find many receipts, especially among the friars. . . .

Always purchase whole cinnabar. . . . That which is convex on the top, and covered with needle-shaped filaments, is the best." It has been suggested more than once that the old masters used the native cinnabar, but, on the whole, the evidence is, I think, against this view. Evidently Cennino, at any rate, was familiar with the artificial variety.

No people have been more famous than the Chinese for the preparation of vermilion, and they still have a deservedly high reputation for it. It seems to have been used by them, from very early times, as a royal colour; and we find, according to Marco Polo, that the paper currency of Kublai Khan was stamped with the royal signature in vermilion. This remains the custom to the present day in China. The Chinese prepare the vermilion now by subliming sulphur and mercury, and then grinding, washing, and floating over. According to an account published in the *Chemical News*, the vermilion is suspended in water containing a little size. In this it settles slowly, and the top layer is then removed. I have examined many samples of vermilion from China. It is a little difficult to get the genuine article, as most of that sent in here is merely European vermilion repacked in Chinese paper. The real article is unmistakable. It is not quite so

bright as English vermilion, but is of a finer and softer colour, and is much more finely ground, being as soft as silk between the fingers. On subliming it, an ash is left, weighing from ·1 to ·05 per cent., or even less, of the whole. The ash is brown, and is apparently a trace of oxide of iron.

Unfortunately, English vermilion-makers have departed from the ways of their forefathers. They prepare a product by heating the black sulphide of mercury with strong caustic potash, and the product is seldom free from alkali and alkaline sulphides.

Chinese vermilion may be safely mixed with white lead. I know a sample so mixed which has remained unchanged for forty years. I should not like to try the same experiment with many of the vermilions made here.

You will ask, is vermilion a permanent colour when properly prepared? This question is somewhat difficult to answer, but I will give you my view of the matter.

In the first place, let us consider the facts before us. Vermilion is a sulphide of mercury. Now, this sulphide can exist in two varieties, the red or vermilion and a black sulphide. We can pass from the black to the red sulphide. We can also, unfortunately, pass very easily from the red to the black

sulphide. If Chinese vermilion (that is practically the same article as Cennino describes) is ground in oil, painted out, and exposed to sunlight in a south window, it *turns black in a few months.* This agrees with Cennino's statement: "But remember that vermilion is not durable when exposed to the air; it is more lasting on pictures than on walls, because, by long exposure to the air, it becomes black when applied to walls."

Evidently, then, Cennino distrusted this pigment, though I venture to differ with his reason for doing so. We know of too many pigments that are affected by air or moisture. The case of vermilion seems to be different from these. No chemical change is needed. The action of the sun's rays alone seems to rearrange the molecules into the black variety. In the experiments on water-colours made by Captain Abney and Professor Russell, it was proved that, while many so-called fugitive colours were permanent in dry hydrogen, this did not save vermilion from turning black.

Now, let us look at the evidence on the other side. I have already mentioned the experiment with vermilion in the late Holman Hunt's studio. But we can get other examples. There are many reds in the National Gallery that can only be produced by ver-

RAPE OF HELEN

By BENOZZO GOZZOLI

Vermilion freely used and perfectly preserved.

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milion. Among others, the red in the *Rape of Helen*, reproduced here.

How, then, are these apparently contradictory facts to be reconciled? If we accept the theory put forward by Abney and Russell, that the rate of destruction of a pigment is a function of the amount of light falling on it, and that, consequently, a feeble light for 100 years produces the same effect as a strong light for one year, we cannot reconcile these facts. But this opinion of theirs has not been accepted by the best authorities, such as Professor Church; nor does it agree with the experience of chemists in other directions. Let us take, as an example, the action of heat in assisting chemical change. There are some changes which take place at a gradually accelerating rate, as the temperature is raised, but there are others which do not begin appreciably until a certain temperature is passed. Vermilion is a case of this kind. It does not change in the diffused light of a room, but is quickly altered by direct sunlight. In this way only can I account for the facts before us. Under proper conditions, then, vermilion, properly made, is, I believe, a reliable pigment, and may be safely used. European vermilions, unless carefully washed with weak acid, and then with water, are not

reliable. In this way 70 per cent. of the ash is removed.

Minium or Red Lead.—This pigment, prepared by the careful roasting of litharge, has been long known. It is described by Pliny, and, according to this authority, was discovered 320 B.C. There can be no doubt that this pigment has been much used in the past, and it is still very largely used for house-painters' work. It is, however, very rarely used by artists, as it has fallen completely into discredit. To my mind there is no more beautiful red, and I think it is a great loss to the palette. Two reasons for not using it are usually given. One, that it tends, like all lead pigments, to blacken in impure air. The other, that it is actually decomposed by daylight, returning to the dull brownish-yellow litharge. It is of interest here to note what Cennino Cennini says of it: "This pigment is only proper to be used in pictures; for if it be used on walls, on exposure to the air it suddenly becomes black, and loses its colour." It used to be customary to wash it before use with wine and water. One curious receipt for preserving minium is given by De Mayerne, a physician in the court of Charles I., to whom I shall have to refer very fully in later chapters. He advises washing it repeatedly with vinegar. More

than one reference shows that it was not considered a very safe pigment. It was prepared by roasting white lead. It is now, I believe, usually prepared from litharge. No doubt the minium prepared from white lead would be a finer pigment. I have not made any experiments with it myself, but I propose doing so, as I doubt if it is rightly condemned, and its beauty makes it well worth reintroducing to the notice of artists.

Amatisto.—There seems to be considerable doubt as to the nature of the pigment so called by Cennino Cennini. He says it is a natural colour, and is produced from a hard, firm stone from which burnishing tools can be made. It is a purple colour, and is probably a variety of hæmatite. (Mrs Merrifield seems to think it may have been native cinnabar.) One curious point is that Cennino says it is the colour that cardinals use. "The cardinals had the red hat by a decree of the Council of Lyons, held in 1245 by Innocent IV. They did not adopt the red dress till 1464, that is, under the pontificate of Paul II.; therefore at the period when Cennino was living they still wore the purple colour" (Tambroni).

Dragon's-blood.—I have already referred to this resin in the third chapter. It is mentioned by Pliny, and is the resin obtained from the calamus palm

(*Pterocarpus Draco*, Linnæus. Dragon tree). Cennino says of this pigment, "Let it alone; it will never do you much credit."

Lake, which comes next in order, I shall treat of in a special chapter.

Yellow Ochre.—Nothing need be said about this pigment. A natural earth, it has been used from the earliest times, and is absolutely permanent. Cennino describes a very fine variety he found near Casole.

Giallorino.—The history and nature of this pigment are somewhat obscure. Cennino distinctly states that it is a volcanic product. He states that it is not a brilliant yellow, though brighter than ochre, and never makes bright greens. Mrs Merrifield considers that several pigments were included under this name. I cannot do better than quote her summing up of this matter.

1. "A native mineral yellow pigment, known by the name of *giallolino, giallolino di Napoli, jaune de Naples, luteolum Napolitanum.*"

This is doubtless the yellow referred to by Cennino. All trace of it seems to be lost, though probably a proper search in a volcanic district would lead to its discovery.

2. "An artificial pigment which was composed of the yellow protoxide of lead, and which was called

giallolino, giallolino fino, giallolino di fornace di fiandra, luteolum Belgicum genuli (the last is a Spanish term), and *massicot*, of which there were two varieties, namely, the golden or yellow, and the white or pale *massicot*."

This pigment can be prepared by gently roasting white lead. It is now known as Turner's yellow. It is apt to turn black, like all lead pigments, the fault of our towns, not of themselves.

3. "An artificial pigment made at Venice, composed of *giallolino fino* and a certain kind of *giallo di vetro*, or vitreous yellow, for which a receipt is given in the Bolognese MS. in the Venetian dialect, and which appears to have been the Hornaza of the Spaniards."

This receipt is worth quoting, and is as follows:—

"To make yellow glass for paternosters or beads:—Take of lead 1 lb., of tin 2 lb.; melt and calcine them, and make glass for paternosters.

"To make *giallolino* for painting:—Take 2 lb. of this calcined lead and tin, that is, 2 lb. of this glass for paternosters, $2\frac{1}{2}$ lb. of minium, and $\frac{1}{2}$ lb. of sand pounded very fine; put it into a furnace and let it fine itself, and the colour will be perfect."[1]

[1] MS. of the fifteenth century in the library of the R. R. Canonici Regolari, in the Convent of the St Salvatore in Bologna.

This pigment must have been a yellow lead frit. Probably effective on fresco walls, but of little or no use in oil. Mrs Merrifield then goes on :—

"I consider it established that they used two kinds of Naples yellow, namely—

"1. A native mineral pigment found in the neighbourhood of volcanoes, the nature of which is not accurately known, and which was called *giallolino di Napoli* and *jaune de Naples*, and which is synonymous with the first kind of giallolino above mentioned.

"2. An artificial pigment now in use composed of the oxides of lead and antimony, called *giallo di Napoli*, *jaune de Naples*, and Naples yellow, and which was not known to the Italian artists."

Apparently the manufacture of the more modern artificial Naples yellow has now ceased. I failed to find either that it was made or that anyone had ever heard of its being made in Naples. The manufacture has long ceased, apparently. The colour now sold as Naples yellow is, I understand, usually a mixture of yellows. One sample I examined was massicot pure and simple. A fine yellow can be made from lead and antimony, and I have some which I have made myself. Possibly a search on Mount Vesuvius might result in the rediscovery of the original Naples yellow.

Orpiment or Auripigmentum.—This sulphide of arsenic exists both as a natural and artificial pigment. The natural sulphide is found in volcanic districts. It has not been found in any of the ancient Greek or Roman paintings. Cennino says it is unfit for use in distemper, because it turns black. Cennino mentions it as being an artificial pigment. It was known and used through the best periods of art, but always with special precautions, as being liable to change and to attack other pigments.

Cornelius Jansen says: "Orpiment will ly fayre on any colour except verdegris, but no colour can ly fayre on him; he kills them all."

De Mayerne, speaking of Vandyck, says: "He makes use of orpiment, which is the finest yellow that is to be found, but it dries very slowly, and, when mixed with other colours, it destroys them. In order to make it dry, a little ground glass should be mixed with it. In making use of it, it should be applied by itself, the drapery (for which alone it is fit) having been prepared with other yellows. Upon them, when dry, the lights should be painted with orpiment; your work will then be in the highest degree beautiful."

This addition of powdered glass is advised by Cennino for another reason. It will be noted, from

these accounts, that it does not seem liable to alter in itself, but to act on other colours. If it was liable to change, it would be advisable to use some different medium than oil. There can be no objection apparently to using it in the way stated, but it would not be safe to put it into the hands of a modern artist, as he would probably mix it too freely with other colours. The reason for not painting it over with verdigris will be given when we come to that pigment.

Risalgallo Realgar, or Red Orpiment.—This pigment, prepared by heating gently orpiment, has similar properties, and must be used with the same precautions.

Zafferano (*Saffron*).—Cennino recommends preparing this colour by putting the saffron in a bag and rubbing it down with lye. He says it is good for staining linen or paper, and it makes a beautiful green with verdigris, but must not be exposed to the air. This is, if course, a very fugitive colour, and was probably only used for temporary purposes. Saffron has already been mentioned as suitable for colouring varnishes.

Arzica.—Cennino says that this pigment is not durable when exposed to the air, and is not to be used on walls. According to the Bolognese MS.,

it is a lake prepared from weld (wild mignonette). It is probably the most permanent of the yellow lakes. When used for dyeing, weld yields a very beautiful yellow, which stands exposure to sunlight remarkably well, and is probably the most permanent yellow dye. It was used by William Morris for his tapestry work. At the same time the yellows in the old tapestries do not seem to bear exposure and time so well as the reds and blues. In many cases they are almost completely gone. So that Cennino's judgment of this pigment is probably correct.

This completes the list of yellow pigments mentioned by Cennino Cennini. He has, however, omitted one of the first importance from the list, to which he devotes a great part of his book, namely, gold. He describes elsewhere the grinding up of gold leaf for use in miniature painting, and, as his panels are laid on with gold, he depends on it for many of his effects. The use of gold as a yellow pigment, however, apart from decorative work, is not common, as far as my experience goes. It is, however, used by Holbein, the process being apparently to lay on the gold, and then glaze with dull yellow up to the high lights, just allowing the gold to show through at the high lights. Another remarkable instance is the famous rainbow portrait of

Queen Elizabeth. The inner lining of the robe is a rich yellow. The high lights are given by means of gold.

Those who have not tried do not know what a wonderfully rich effect can be produced by the glazing over gold of transparent pigments.

Verde Terra (*Terre Verte*).—There is no need to say anything about this natural earth. Like the ochres, it is useful and absolutely reliable, and always has and always will be used. Cennino says that it may be used instead of bole for preparing the surface for the gold.

Verde Azzurro.—Cennino says that this green is prepared from azzurro della magna. He also states that it must not be ground too fine, as it loses its colour. According to Mrs Merrifield, however, verde azzurro is a native copper carbonate, similar to green bice. Cennino's description certainly suggests a frit of some kind, as the frits are spoiled by too fine grinding. It is not impossible that the azzurro della magna (blue copper ore) was converted into a green pigment artificially. There can be no doubt, however, that green copper ores were known and used as pigments. I shall, however, discuss this point at greater length when I come to the copper blues.

Verderame (*Verdigris*).—Of this pigment Cen-

nino says it is good in pictures tempered with glue, but must never be mixed with white lead. He also says it is improved in colour by grinding with vinegar, but is not durable.

This pigment was largely used apparently both by the Italian and Flemish painters. It was prepared by exposing plates of copper to the action of acetic acid vapour, and it is a subacetate of copper. A finer preparation was made by dissolving it in vinegar, and letting it crystallise out. This preparation was known as *verde eterno*. It is a very transparent blue green, and was used to glaze over other colours. A drapery, for instance, painted in yellow and glazed with verdigris would be of a fine green. The brilliant greens in the original manuscript from which the picture on page 250 is photographed are probably painted with verdigris. The green is, however, a fine one, especially as no yellow brighter than ochre is used in the solid painting. Verdigris is perhaps the most interesting of all the pigments used by the old masters, as we know it to turn black and to invade and destroy other colours. Its successful use by them, therefore, is little short of marvellous. I will treat of this, however, at some length when the mediums used by the old masters come under discussion, and it will be our most interesting

example of what can be done by the right selection of a medium.

Bianco Sangiovanni (*Whiting*).—This is largely whiting, or chalk, and is recommended for fresco work by Cennino Cennini. His method of preparation is, however, a beautiful one. He takes slaked lime, and, mixing it with water, keeps it for eight days, changing the water every day. He then makes it into small cakes, and lets them dry in the sun. As he says, the older they are (that is, the more completely they change back into carbonate) the whiter they become.

Biacca (*White Lead*).—Cennino says that it must not be used for fresco, as it turns black, but may be used on pictures. This pigment was apparently known to the ancients, though not used on walls. It always has been, and still is, prepared (some of it) in the same way, by the action of vinegar vapour on metallic lead ; a process popularly known as the Dutch process. There is no reason to suppose that the pigment made now by this process differs in any way from that used by the old masters. Under the name of flake white it is used to-day for oil-painting. It may be as well to explain here, and now, certain points about this pigment which seem to be not clearly understood by artists.

In the first place, it is necessary to understand that stack lead, as I shall call it, that is, white lead made by the action of acetic acid vapour on lead plates, contains two substances, one known as carbonate, the other hydrate of lead, and it owes its peculiar properties to the intimate union in the right proportion of these two. One of the most important of these properties is its power of combining with the oil to form what is known as a lead soap, thus forming a leathery substance of great durability. All the so-called permanent whites do not do this, and, consequently, remain merely a mixture of particles of pigment with the oil. Furthermore, a great deal of white lead is made now by a precipitation process. It is whiter than stack lead, and therefore preferred by artists; but it does not combine with the oil, as stack lead does, and is not so reliable. A mixture of the two is also sold, which is fairly satisfactory, I think.

Now, to illustrate what I mean by this combining with the oil, I will describe an experiment made by a manufacturer of whites. He coated some pieces of canvas with different whites, such as patent white, precipitated white lead, and so on, and fixed them up on a roof, where they would flap about in the wind and get all the weather going.

The stack lead canvas was not affected by this treatment, but the other whites cracked and dusted off. On the other hand, exposure tests on wood have conclusively shown that zinc white or mixtures of zinc white and lead whites such as lead sulphate stand exposure better than white lead.

To go on to another point—the darkening of white lead. In impure air, containing certain compounds of sulphur, white lead turns to an unpleasant brown. If, however, it is then exposed to sunlight, it quickly recovers again and returns to its original white.

Besides this action, if kept in the dark it becomes of a yellow colour, not disagreeable. This is quite different from the effect of sulphuretted hydrogen, but can also be removed by exposure to sunlight.

The ease with which white lead is thus restored has not, I think, been allowed for sufficiently in considering its instability as a pigment.

Azzurro della Magna. — According to Mrs Merrifield, it is a blue copper ore. Cennino says that it is found in the veins of silver mines, and that it comes from Germany and from Greece. There was, probably, no blue more universally used than this during the best periods of Italian art. It is repeatedly referred to, and Professor Branchi, of

Pisa, has found it in many old pictures and frescoes. I do not doubt that blue often seen on the walls of our cathedrals, where a little of the old colouring remains, is this copper ore. It is true that the original preparation of copper blues seems to have come in also very early, and it is difficult, therefore, to say which may have been used in any particular case. I will not trouble you with all the information collected on this point. With reference to the use of copper blues in painting, however, a few remarks are necessary. In the first place, it seems to have been the practice to lay on this blue with size and not with oil, the opinion being that in oil it turned green. Whether this is so or not is deserving of an experiment. In order to be able to use size in an oil-painting, the oil surface was rubbed with a little garlic. In this way a sticky surface was formed on which the size could grip. The use of size in this way is undoubted, and has been found in restoring some ancient pictures. Doubtless, also, the blue would be laid on with *certain* varnishes; but this point must be left in the meantime. After laying on with size it was varnished over in many cases.

In fresco, of course, these difficulties would not present themselves. Copper blue and green have fallen into great discredit in modern times, and I

propose to consider here shortly how far this is justifiable.

In the first place, their use in oil seems to have been always objected to, certain varnishes or size being used. But if used with size there seems to be no reason to doubt their durability in pure air. Copper tends, under certain conditions, to oxidise and carbonate into blues and greens, as is seen on old bronze. This is the final product from exposure to damp and air, and doubtless a stable one. The fact of similar colours being found in copper ores confirms the view that copper blues and green, at any rate of native origin, should be stable compounds.

Can they then be recommended for use now in painting? I fear not, and because of our old enemy, sulphur. In the pure air of a country house, where gas has never been heard of, I would not fear to use them, but they are, I consider, more susceptible even than white lead, and for this reason. White lead is easily restored, at least in oil, by exposure to sunlight. Copper, I believe, will be found not to recover in the same way. It will gradually blacken without recovery. Consequently the reintroduction of copper ores for modern work cannot, I fear, be recommended.

We have discussed elsewhere the Egyptian blue and the more modern smalt, apparently both unknown to Cennino Cennini.

They are quite useless in oil, as fine grinding immediately destroys their beauty, but are, I believe, especially applicable to fresco work. I know of no blue at present in the market which can be more safely recommended for fresco-painting, and I think that these blues might well be revived for this purpose. The manufacture of a cobalt frit or common smalt might well be improved, so as to make a reliable pigment of it.

Azzurro oltre Marino (*Ultramarine*).—We now come to the most famous of all blues, real ultramarine, prepared from lapis lazuli. Cennino says, "Ultramarine is a colour more noble, beautiful, and perfect than any other colour; and its good qualities exceed anything we can say in its favour." The utmost pains used to be taken with its preparation from the stone, and it was always very expensive. Certain monasteries were famous for preparing it, and supplied it to the artists they employed; and many stories are told of their stingy ways with this colour, and how they suspected the artists of stealing it, and so on. It is still prepared, but has been replaced by the artificial ultramarines. These are

similar in chemical composition, and very beautiful, and the best qualities seem durable. But it is very questionable if they equal in any way the real article. I quote in full Cennino's description of the method of preparing this colour. It is very similar to the receipts given in other MSS. :—

"CHAPTER LXII

"*Of the nature of azzurro oltre marino (ultramarine blue), and how it is prepared*

"Ultramarine blue is a colour noble, beautiful, and perfect beyond all other colours, and there is nothing that could be said of it but it will still exceed this (praise). On account of its great excellence, I shall speak of it at length, and give you full directions for preparing it; and you must pay great attention to them, that you may gain honour and service from them. And with this colour, together with gold (which adorns all the works of our art) let everything be resplendent, whether on walls or panels.

"First take some lapis lazuli; and if you would know how to distinguish the best stones, take those which contain most of the blue colour, for it is mixed with what is like ashes. That which contains least of this ash pigment is the best; but be careful that

you do not mistake for it azzurro della magna, which is as beautiful to the eye as enamel.

"Pound it in a covered bronze mortar, that the powder may not fly away; then put it on your slab of porphyry, and grind it without water; afterwards take a covered strainer like that used by the druggists for sifting drugs (spices) and sift it, and pound again as much as is required. But bear in mind that though the more you grind, the more finely powdered the azzurro will be, yet it will not be so beautiful and rich and deep in colour, and that the finely ground sort is fit for miniature painters, and for draperies inclining to white. When the powder is prepared, procure from the druggist six ounces of resin of the pine, three ounces of mastic, and three ounces of new wax to each pound of lapis lazuli. Put all these ingredients into a new pipkin and melt them together. Then take a piece of white linen and strain these things into a glazed basin. Then take a pound of the powder of lapis lazuli; mix it all well together into a paste, and that you may be able to handle the paste, take linseed oil, and keep your hands always well anointed with this oil. This paste must be kept at least three days and three nights, kneading it a little every day; and remember that you may keep it for fifteen days or a month, or as long as you please.

When you would extract the azure from the paste, proceed thus:—Make two sticks of strong wood, neither too thick nor too thin, about a foot long; let them be well rounded at each end and well polished (smoothed). Then, your paste being in the glazed basin into which you first put it, add to it a porringerful of lye, moderately warm; and with these two sticks, one in each hand, turn and squeeze and knead the paste thoroughly, exactly in the manner that you would knead bread. When you see that the lye is thoroughly blue, pour it out into a glazed basin; take the same quantity of fresh lye, pour it over the paste, and work it with the sticks as before. When this lye is very blue, pour it into another glazed basin, and continue to do so for several days, until the paste no longer tinges the lye. Then throw it away; it is good for nothing. Range all the basins before you on a table in order, that is to say, the first, second, third, and fourth; then, beginning at the first, with your hand stir up the lye with the azure, which by its weight will have sunk to the bottom, and then you will know the depth of colour of the azure. Consider how many shades of the azure you will have, whether three, or four, or six, or what number you please, always remembering that the first-drawn extracts are the best, as the first basin is better than the second.

And if you have eighteen basins of extract, and you wish to make three shades of azure, take the contents of six basins and mix them together; that will be one shade. Proceed in the same manner with the others. But remember that if you have good lapis lazuli, the azure from the first two extracts is worth eight ducats the ounce. The last two extracts are worse than ashes—may your eyes therefore be experienced, so as not to spoil the good azure by mixing it with the bad; and each day remove the lye that the azure may dry. When it is quite dry, according to the sorts you have, put it into skins, bladders, or purses, as may be most convenient, and take notice that if the lapis lazuli should not be very good, or if, after having ground it, the colour were not to turn out deep (*violante*) enough, I will tell you how to give it a little colour. Take a little pounded kermes lake (*grana*) and a little verzino, but mind the verzino is grated or scraped with glass; and then boil them together with lye or a little roche alum. And when they boil, and you see that the colour is a perfect crimson, before you have withdrawn the azure from the porringer, but well dried from lye, add to it a little of this lake and verzino, and with your finger mix everything well together; and let them remain till dried, without sun, or fire, or wind. When dry,

put it into a skin or purse, and rejoice in it, for it is good and perfect. And bear in mind that it is a rare gift to know how to make it well. You must know also that it is rather the art of maidens than of men to make it, because they remain continually in the house, and are more patient and their hands are more delicate. But beware of old women. When you use this azure, take as much as you want; and if you are going to work on light dresses, it must be ground a little on your usual stone. And if you want it for laying grounds, it must be very little worked on the stone and always with very clear water, the stone being well washed and clean. And if the azure should get soiled it any way, take a little lye or clean water, and put it into the vase, and stir them well together, changing it two or three times, when the blue will be quite clean. I shall not treat of its tempera, because I shall hereafter describe all the temperas proper for every colour to be used on pictures, on walls, on iron, on paper, on stone, or on glass."

The blacks mentioned by Cennino are three in number: black chalk, a chalk prepared by charring the young shoots of the vine; a black from almond skins or peach stones; and lampblack.

Ivory black was also known, though not mentioned by him. With reference to lampblack, Vasari says that it has a tendency to darken in time, and gives this as the cause of injury to Raphael's *Transfiguration* in the Vatican.

It will be noticed that he mentions no browns. Browns, however, such as umber were known and used, and asphaltum in later times. The successful use of asphaltum is very difficult to understand. Many modern pictures have been spoiled by it, and artists are afraid of it. In some old receipts, however, we are directed to roast it before grinding in oil. Professor Church, in his recent book on pigments, gives his testimony that this is perfectly successful, and the pigment may then be used with impunity, but it is very much less beautiful.

Besides these colours, Cennino mentions indigo, and states that a fine green can be made by mixing it with orpiment. He probably, however, only means it to be used in miniature painting.

He also mentions lakes, but does not describe their composition. The question of the lakes used by the old masters is so important that it will be discussed in a separate chapter.

Having thus gone through the list of pigments given by him, it is of some interest to refer again to

those that he regarded as safe for use in fresco. These were sinopia, amatisto, yellow ochre, Naples yellow, verde terra, bianco sangiovanni, and black. No blue is mentioned, though elsewhere he talks of using indigo, which is difficult to understand. Of these colours one is wanting from the modern palette, namely, Naples yellow. There can be no doubt that as safe a palette can be selected from among modern pigments. As stated in Chapter VI., if blue copper frits are introduced again, or cobalt blue used, with cobalt green and oxide of chromium green, a perfectly safe palette could be made up along with the earths given above.

Cennino Cennini next tells us how to varnish the finished tempera picture, in the following words :—

"You must know that the best varnishing is to delay as long as possible after your picture is painted —the longer the better. And I speak truth when I say that if you delay for several years, or at least for one year, your work will be much fresher. The reason of this is, that the colouring naturally acquires the same condition as the gold, which shuns a mixture with other metals; so that the colours when mixed with their proper tempera dislike the inmixture of other tempera. Varnish is a strong liquor and gives great force (*dimostrativo*), and will be

obeyed in everything, and annuls every other tempera. And suddenly, as you spread it over the picture, the colours lose their natural strength and must obey the varnish, and their own tempera has no longer power to refresh them. . . . Then take liquid varnish, the brightest and clearest you can obtain; place your picture in the sun, wipe it and clean it as thoroughly as you can from dust and dirt of every kind; and take care that it is weather without wind, because the dust is subtle, and every time that the wind blows it over your picture, you will have more difficulty in making it clean. You might well varnish in such a place as a green meadow or by the sea. . . . When you have warmed the picture in the sun and the varnish also, place the picture level, and with your hands spread the varnish all over thinly and well . . . or dip a small piece of fine sponge in the varnish, rolling it with the hand over the picture."

It is evident from this account that the varnish was thick, and had to be warmed and then rubbed on with the hand. Its probable composition is discussed in the chapter on varnishes. We have thus obtained by a study of this MS. a very complete picture of the whole procedure in his time necessary for the painting for tempera pictures. The final pro-

cess of varnishing has not usually lasted on these pictures, the varnish having crumbled off through time and left the uninjured egg-picture underneath, which has in many cases again been varnished in modern times. Such protection by varnish is no doubt very necessary for such pictures, as they are easily injured by scratching, dirt, and injurious gases. The remarkable fact remains, however, that though egg is not the medium one would have selected as likely to endure through the centuries, these pictures have remained fresh and firm, while oil-pictures have darkened, wrinkled, cracked, and fissured, have, in fact, been destroyed by the medium with which they have been painted, not through the fault in most cases of the pigments which have been used.

In the following chapters Cennino Cennini discourses on oil painting:—

"CHAPTER LXXXIX

"How to paint in oil on walls, panels, iron, or whatever you please

"Before we proceed further, I will teach you to paint in oil on walls, or on panels, which is much practised by the Germans, and in the same way on iron or stone. But we will first speak of walls.

"CHAPTER XC

"How to begin painting in oil on walls

"Cover your wall with plaster, exactly as you would do when painting in fresco, except that where you then covered but a small space at a time, you are now to spread it over your whole work. Make your design with charcoal, and fix it with ink or verdaccio, tempered. Then take a little glue, much diluted with water—a whole egg, well beaten in a porringer, with the milky juice of the fig-tree, is a still better tempera—you must add to the said egg a glassful of clean water. Then, either with a sponge or a very soft brush without a point, go once over the whole ground on which you are going to paint, and leave it to dry for one day at least.

"CHAPTER XCI

"How to make oil fit for tempering colours, and also for mordants, by boiling over the fire

"It will be very useful to you to know how to prepare this oil for many things that are done; therefore, take one, two, three, or four pounds of linseed oil, and put it into a new pipkin; if it is glazed, so much the better. Make a small furnace, and make a round hole, into which the pipkin fits exactly, so

that the flame may not reach it, because the fire easily catches it, and there would be danger to the oil, and also of burning the house. When you have made your furnace, put a moderate fire in it; and the more slowly your oil boils, the better and more perfect will it be. Let it boil until it is reduced to half the quantity. But to prepare mordants, when it is reduced to half the quantity, add to each pound of oil one ounce of liquid varnish (*vernice liquida*), and let it be very fine and clear; and oil thus prepared is good for mordants.

"CHAPTER XCII

"*How to prepare good and perfect oil by cooking it in the sun*

"When you have prepared this oil (which is also cooked in another way, better for painting, but not for mordants, for which it must be done on the fire, that is, cooked), take your linseed oil, and in summer time put it in a basin of bronze or copper. And in August (*quando è il sole leone*) place it in the sun; and if you keep it there till it is half wasted, it will be exactly right for mixing with colours. And you must know that, in Florence, I have found the finest and best that there can be.

"CHAPTER XCIII

"*How to grind colours in oil and to use them on walls*

"Let us return to grinding the colours. Begin and grind colour by colour, as you did when working in fresco, except that where you then ground them with water, you must now grind them with oil. And when you have ground them, that is to say, all the colours (for every colour can be mixed with oil except bianco sangiovanni), provide small vessels, either of lead or of tin, into which put these colours. And if you cannot find such, get glazed vessels, and put the ground colours into them; put them in a box, that they may keep clean. When you would paint a drapery with three gradations of colour, as I have previously taught you, divide the space, and let each colour be laid in its proper place with a minever brush, uniting one colour well with another, the colours being very stiff. Then stop for a few days and return again to your work; see how the paint covers, and repaint where necessary. And in this way paint flesh or anything you please, and in this way mountains, trees, and every other work. Provide a vessel of tin or lead (something like a lamp), about the height of your finger, half fill it with oil, and keep your brushes in it that they may not dry."

This oil would be thicker than that used by artists to-day, and would rather resemble lithographic varnish, and be stiff to grind pigments in and to paint with. I discuss its properties at greater length when considering the whole subject of oil-painting. It is evident from these chapters that Cennino Cennini was not only aware that everything could be done in oil, but had himself experimented with it.

Finally, though Cennino Cennini mentions varnish (*vernice liquida*), he tells us nothing of its composition. Besides mixing it with thickened oil as a mordant for laying on gold, he also uses it for his finished tempera pictures.

We have next to consider the egg mediums described by Cennino Cennini, and the way in which he directs them to be used. Of these the most important is the yolk of egg. In the part of this book dealing with fresco I have already mentioned that for painting on the dry wall surface Cennino Cennini advises a medium of white and yolk of egg and fig-tree juice. This, however, is not his medium for panel pictures. For these he recommends simply the yolk of the egg.

In chapter lxxii.—the one already quoted as giving the list of pigments safe for buon fresco—he says: "The first tempera consists of the white and yolk

of an egg, into which are put some cuttings of young shoots of the fig-tree ; beat them well together, then add some of this tempera moderately, neither too much nor too little, to each of the vases, like mixing half wine with half water. . . . If you use too much tempera suddenly, the colour will crack off the wall. . . . The second kind of tempera is the yolk of egg only ; and you must know that this tempera is of universal application on walls, on panels, and on iron, and you cannot use too much of it ; but be sure and take a middle course." Again, in chapter cxlv., he says: "You must always temper your colours with yolk of egg" for panel-painting. There can be no doubt, therefore, that yolk of egg was his tempera, the pigments being first ground in and kept wet with water. The proportion between egg and water is, however, left uncertain ; but apparently the yolk of egg, after breaking up, is mixed with an equal quantity of water and this used to blend with the pastily wet pigments. With this medium thin and repeated paintings were made one over the other.

For the whole technique the reader is referred to Mrs Herringham's translation of Cennino Cennini. Besides this universal tempera, Cennino Cennini advises the use of size in the case of saffron, orpiment and ultramarine, orpiment and indigo; and, for ver-

digris, size on panels, but yolk of egg on parchment or paper. Mrs Herringham has not found it practicable to use size in the same picture with yolk of egg. Besides receipts for the preparation of parchment glue, Cennino Cennini mentions fish-glue more than once, and honey, but not as painting mediums. He also refers to linseed oil for making paper transparent, as well as a painting medium. The reference to linseed oil by Cennino Cennini is of great interest as showing what was known of this medium long before oil-painting became customary in Italy.

CHAPTER XI

ON THE PAINTING OF ILLUMINATED MANUSCRIPTS

In the course of the various chapters dealing with the receipts from Theophilus, Cennino Cennini, and others, a considerable amount of information has necessarily been given on the subject of the illuminating of manuscripts; but it is, nevertheless, necessary to bring it to a focus in one place in order to make the information intelligible and connective. It is not part of the purpose of this book to deal with the history of illuminated manuscripts, or to consider the various developments of decorative art in connection with them. We have already said something of the painting on papyrus MSS. in Egypt, and the illustration on page 21 is an example of this kind of Egyptian art; but we have now to deal with the efforts of later times.

During the time of the Byzantine Empire very beautiful illuminated MSS. were produced, and more

especially for the use of the Byzantine emperors, manuscripts stained purple with murex and written in letters of gold. These manuscripts were principally books of the Gospels, and many of them are still in existence. The purple staining seems to have faded considerably, but the pigments have retained their freshness.

Beautiful illuminated manuscripts were also produced during the reign of Charles the Great and his successors. This revival of the illuminator's art was due to the aid of Alcuin of York, who was abbot of the Benedictine monastery of St Martin at Tours. A beautifully illuminated copy of his revised edition of the Vulgate exists in the British Museum.

But the history of illuminated MSS. is very specially associated with these islands, and especially with Ireland. The Irish Church was founded about 430 A.D., and by the middle of the seventh century the Irish monks had learned to produce both goldsmiths' work and illuminated manuscripts with a taste and skill of the highest order. The delicate work executed in gold influenced largely the decorative treatment of the vellum surface owing to the fact that the same monk practised both arts. The most famous example of the work of this period is the *Book of Kells*, in the library of Trinity College,

Dublin. The sheets of vellum are occasionally stained purple after the Byzantine manner—the Irish monks had learned how to extract the purple dye from a variety of murex found on the shore of the Irish Channel,—but both gold and silver decoration is absent from these early manuscripts. The art was introduced into England by Irish monks, and for many centuries the finest illuminating work was done in this country. One of the most famous centres for the production of this work was the Abbey of Lindisfarne. In the year 635, at the request of Oswald, King of Northumbria, an Irish monk, Aidan, came from Iona to preach the Gospel in Northumbria, and selected the island of Lindisfarne as his headquarters. Here was prepared the "Book of the Gospels of St Cuthbert," the writing being done by Eadfrith, "in honour of God and of Saint Cuthbert," the illuminations by Æthelwold, afterwards ninth Bishop of Lindisfarne, and the gold and gem-studded case by Bilfrith. Owing to the constant harrying of the abbey by the Vikings, the monks, in the year 878, fled from the island with the body of St Cuthbert and the "Book of the Gospels." The box containing the Gospels was washed overboard, and the ship finally driven back and stranded on the shore, where the monks, to their joy, found the box

with the manuscript miraculously preserved, and, according to Symeon, uninjured. The MS., which is to-day in the British Museum, shows, however, traces of the injury done by the salt water, but is on the whole wonderfully preserved.

The English art of illuminating reached its highest perfection in the thirteenth century, more especially during the long reign of Henry III., from 1216 to 1272; but fine work was still executed through the fourteenth and fifteenth centuries, although mixed with a great deal of inferior work.

In France the illuminating of MSS. flourished under King Louis IX. (1215–1270) as much as it did in England, and in the fourteenth century the French MSS. are the finest being produced at that time. The fifteenth and sixteenth centuries are periods of decline in the production of these works of art. The demand for illuminated MSS. had grown enormously, with the result that it passed out of the hands of the monks, and in Paris, Brussels, Antwerp, Bruges, Ghent, Arras, and other French and Flemish cities, large numbers of secular writers and illuminators grew up, and special guilds of illuminators were formed. Ultimately the art is destroyed by the invention and development of printing, though for some time both are found being carried on side by

side, and a combination of both arts is to be found in the *Books of Hours*, produced in Paris during the close of the fifteenth and beginning of the sixteenth century, printed on vellum, decorated with woodcut borders, and illuminated by painting in gold and opaque colours over the engravings. For this brief historical account I am indebted to the late Professor Middleton's *Illuminated Manuscripts in Classical and Mediæval Times.*

The manuscripts were usually written and painted on vellum, though paper was sometimes used, and the pigments and mediums were those already described. Special attention was given, among other things, to the application of gold. This was done in two ways, either as gold leaf or gold paint. When applied as gold leaf it was usually burnished, and for this purpose required to have underneath it a firm bed, which was usually slightly convex. Many different mixtures for this foundation are given, but it usually consisted of a mixture of whiting with white of egg or parchment-glue, mixed with a red ochre to colour it. This was laid on with a brush, allowed to dry, polished with a burnisher, and then the gold leaf attached with white of egg. Ultimately the gold leaf was also burnished with the dog's tooth or other burnisher.

The old gold leaf was, it must be remembered, much thicker than the gold leaf of to-day, and was sometimes laid on two or three layers thick before burnishing. The other method of using gold was to grind up the leaf with white of egg or gum and then paint it on. This gold paint was also capable of some partial burnishing, apparently, from the directions given, but was as a rule left dead. It is used in two ways, namely, as part of the decorative scheme, and also as a yellow in high lights. Very often a rich effect is produced by many very fine lines of this dead gold running through a piece of painting. In the particular example of an illuminated *Book of Hours*, given on page 250, the dead gold is represented entirely by yellow in the reproduction. If the page is held so as to look straight at it, the gold has merely a yellow effect; but the slightest movement of the position of the pages brings out the metallic sheen. It is practically impossible to reproduce the delicate interlacing of gold paint by means of modern methods of reproduction. This *Book of Hours*, which is in the possession of the University of Edinburgh, is a very dainty little volume, bound in velvet, and written upon vellum, with ornamented borders and fine miniatures, in the first of which is painted the arms of the Duke of Anjou. On the flyleaf it is written

FROM A "BOOK OF HOURS"

Bright Crimson, predominating; Blue—probably ultramarine; also Vermilion and possibly Lake, Yellow—Gold Paint. (Edin. Univ. Library)

that it became in 1586 the property of the Chevalier Balthazar Remiel, and that it had belonged to his grandmother, Joan Bertrand. It is apparently late fifteenth-century French work.

This use of gold as a yellow pigment is not peculiar to illuminators of MSS. A very remarkable example is to be seen in Holbein's *The Ambassadors*, in the National Gallery, where the gold chain is painted with yellow ochre, with particles of gold leaf for the high lights. The staining of the vellum was not only done with murex, as Cennino Cennini gives several receipts for staining vellum different colours. These receipts are not properly for stains at all, as they consist of very thin washes of pigments mixed with a little size. Such staining, however, does not seem to have been common. The black ink used in the earlier times was simply lamp-black and gum water, but in later times an ink made like our modern ink was used. Theophilus, as we have seen, gives a receipt for an ink of this kind, containing tannic acid and iron. These inks have in many cases badly faded. The older ink is quite indestructible, and corresponds to what we now know as Indian ink. Vermilion and red lead are used for red inks. The many pigments already described are available for miniature-painting, but judging by

their appearance the actual palette was fairly limited. Verdigris is easily recognised in many cases, and red lead and vermilion, lake and ultramarine.

How far the "folium" colours were used it is difficult to say, but it is very unlikely that they have stood the test of time. Many hues of the fugitive pigments already described were not necessarily unsuitable for illuminating MSS., as they were so seldom exposed to the light. The mediums were, as we have seen, white of egg, parchment-glue, gum, fish-glue, and for verdigris merely wine, the verdigris being worked in more as a stain than as a pigment. The selection of these mediums for certain pigments was somewhat capricious, and the advice of Theophilus on this matter has already been quoted on page 167. Probably of these mediums white of egg proved the best and safest, and gum the worst, as it would be more likely to crack and flake off. For those who may wish to revive and experiment on the illuminating of vellum, therefore, the best advice would be to buy dry pigments, and to grind them in white of egg as wanted, and to use thick gold leaf, both for laying on as leaf and for grinding up with white of egg as paint. If the pigments are carefully selected there should be no difficulty in producing beautiful and permanent work.

CHAPTER XII

ON THE PREPARATION OF THE LAKES USED BY THE OLD MASTERS

In discussing the pigments used in classical times we have found that the preparation of pigments from animal and vegetal dyes was evidently understood. The simplest form of such a pigment is the colouring matter extracted from a plant and evaporated to a thick consistency and mixed with gypsum or chalk. Such a preparation is, however, unsatisfactory, because the pigment is not really suited to the chalk base. Another method of using such extracts is to mix them with a little gum or glue water, and lay them on as transparent stains upon the surface. In the case, however, of many of the most brilliant and permanent dyes the colour is not properly developed under these conditions, and a mordant of some kind is required which, uniting chemically with the dye, fixes it to the cloth, or chalky

base, and at the same time develops its colour. In some cases, for instance, the colour of the mordanted dye is quite different from that of the dye itself. To give a striking example, alizarin, the dyeing principle of the madder root, is an orange-yellow colour, but when mordanted into the cloth with alum is red. The dyes from madder (red to crimson), woad (blue), weld (yellow), kermes (red to crimson), and murex seem to have been known from very early times; and to this list we can add others, such as the dyes from certain lichens like litmus, and the yellow dyes from Persian berries and quercitron bark. The dyes from saffron- or Brazil-wood do not seem to have been known in classical times, but were very familiar from the thirteenth century onward. As already explained, in the first instance a base such as a chalk was usually used, and alum or some similar and closely related body used as the mordant; while in the case of the Egyptian madder the base was gypsum and the mordant lime. But in later times the use of alum as a mordant was extended to the use of alumina as a base. If alum is dissolved in water and some soda added, a white, flocculent, translucent precipitate of alumina is formed, which, if dried and ground in water or in oil, is almost transparent. If the alum or

soda solution contains also in solution a suitable dye, then the precipitate during formation absorbs the dye, and the resulting product is what is now known as a "lake," whether the dye be madder, or cochineal, or another. Accordingly we find that the earliest receipts are for pigments prepared as in the classical times on a chalky base, the discovery of how to obtain what we mean by a lake coming later. Accordingly we find in the older MSS. receipts for preparing lakes of the simplest kind.

For instance, a receipt for the preparation of lake in this way occurs in the manuscript of Eraclius, which is regarded as not being later than the thirteenth century :—

"Thus when painters wish to imitate sil atticum they put dried violets into a vase of water over the fire to boil, and when boiled down they are strained through a linen cloth, and rubbed down in a mortar with chalk, and so a colour like sil atticum is made."

Again we find Eraclius says :—

"Flores in varios qui vult mutare colores,
Causa scribendi quos libri pagina poscit,
Est opus ut segetes in summo mane pererret,
Et tunc diversos flores ortuque recentes."

"Inveniet properetque sibi decerpere eosdem,
Cumque domum fuerit, caveat ne ponat in unum,
Illos, sed faciat quod talis res sibi poscit
Desuper equalem petram contriveris istos
Flores; incoctum pariter tum contere gypsum,
Sic tibi siccatos poteris servare colores.
Ex quibus in viridem si vis mutare colorem,
Calcem commisce cum floribus; inde videbis
Quod tibi mandavi, veluti prius ipse probavi."

The above quotations are taken from Mrs Merrifield's translation of the manuscripts of one "Jehan le Bègue," notary to the masters of the mint in Paris, who compiled them (1431) from the manuscripts of one "Jehan Alcherius." They contain the receipts collected by Jehan Alcherius himself, the manuscripts of Petrus de S. Audemar, of Eraclius, and part of that of Theophilus. Mrs Merrifield has corrected the version of Eraclius, and the manuscripts of Jehan le Bègue, by the copy of Eraclius bound up with Theophilus, and found by Raspe in Trinity College Library, Cambridge, now at the British Museum (Egerton Manuscripts, 184A).

It will be seen that when a purple colour is required, a neutral substance is used; when a green, lime is added. The colour in the former receipt is consequently green.

In order to use the colours thus prepared for illuminated manuscripts, they were mixed with a little gum arabic or white of egg beaten up, directions for this occurring frequently. I have prepared a green pigment by boiling the petals of violets with water, filtering and evaporating the filtrate slowly with a little French chalk and gum arabic.

The result shows that such pigments can be prepared with no great difficulty, and would doubtless give soft and pleasing tints.

Eraclius gives also another method of preparing lake by allowing ivy juice to slowly evaporate in a porous jar till thick enough to use as a colour.

"*De Edera et Lacca*

Propositis rebus edere satis utile robur.

. . . . . .

Vere novo, reduci cum gaudent omnia succo,
Arboribusque refert humor, . . .

. . . . . .

Nam subula rami, loca per deserta forati,
Emittunt viscum, quem qui sibi sumpserit illum,
Transferet in rubeam coctum prurigine formam ;
Sanguineumque sibi leviter capit ille colorem,
Hunc sibi pictor amat et scriptor diligit eque.
Hinc etiam roseo fit parcia tincta colore.
Quæ quoque caprinas, quæ pelles tingit ovinas."

The preparation of a lake from ivy is also described by Petrus de S. Audemar.[1] He advises the addition of madder, straining through a cloth, and then evaporating over a fire. "And while it is on the fire, put it frequently with a twig upon your rod to try it. If it is thick enough, let it cool and harden, so that you may be able to make it into cakes."

In this receipt he says take lac, that is, the gum of ivy; and in other receipts the month of March is mentioned as the right time to collect the gum from the young twigs. This gum is referred to in Balfour's *Manual of Botany*, and is stated to have certain medicinal properties, but it is not mentioned in the Pharmacopœia, and the wholesale druggists know nothing of it. I have not been successful in preparing such a lake from the young twigs of English ivy —the expressed juice merely drying up into a dark green—but I have obtained a yellow gum from the ivy in Italy, which, on exposure to air, darkens gradually to a ruby colour on the outside. Apparently, however, to get a fine colour from it, the Italian sun is necessary.

We soon find, however, that these methods are replaced by more scientific ones, derived from the

[1] Supposed to be not later than the end of the thirteenth century. Contains some receipts from Clavicula. A twelfth-century MS.

art of dyeing, which, of course, reached great perfection in very early times. In the MS. of Jehan le Bègue we find several receipts for the preparation of lakes in the modern method, which, as they were compiled by him from the MSS. of Alcherius, belong to the fourteenth century.[1]

We find in these receipts the substance from which the colouring matter is to be obtained is first to be boiled in a ley, made from wood ashes, or with a stale urine, and then the colour precipitated by the addition of alum. Traces of the older method, however, are to be found, as frequently the addition of gypsum as well as alum is mentioned. Some of these receipts indicate considerable knowledge of the properties of alum basic salts, and their tendency to form a precipitate under certain conditions. The following quotations from Mrs Merrifield's translation of the manuscripts of Jehan le Bègue will serve to illustrate the methods used in the fourteenth century :—

" *To make a rose colour.*—Take brixillium scraped very fine with a knife or with glass, and tie it in a

[1] For instance, we find " Continentur hoc volumine de coloribus ad pingendum capitula scripta et notata a Johanne Archerio seu Alcherio, Anno Domine 1398, ut accepit a Jacobo Cona, flamingo pictore Commorante tunc Parisiis," and so on, from Jehan le Bègue.

fine piece of linen, not tight, but loose and easy. And put it, tied up in that manner, into a new glazed earthen jar, to soak in ley or in urine; and if the urine is stale, so much the better. If you cannot have any such, take very strong ley and put with the said piece of linen containing the brixillium some of the white chalk of three or four times the weight of the brixillium, more or less, as by looking at it you may think fit, according to the goodness of the brixillium. Afterwards add some pulverised raw alum, in quantity about one-fourth of the chalk or thereabouts, more or less, and mix all the things together, always leaving the said brixillium tied up in the said piece of linen, and leave it so for about one hour. Next place the jar upon a fire, not of wood, but of charcoal, and let it boil, but not too fast, for the space of a quarter of an hour or less, so as just to melt the alum. Then take the said bag of brixillium out of the vase, and press it and screw it out well, in order that the whole of the colour may run out of it in the said vase; and then remove the colour, hot as it is, from the fire, and put it on a hollow lump of chalk or upon a brick of baked clay, in order that the urine or ley may be immediately absorbed into the stone, and the colour itself remain thickened and half dry. Afterwards let it

dry completely in the sun, and then remove the colour, which is of a rose colour, from the stone or brick with a knife, and put it by for use. When you wish to use it, take as much as you require and powder it, that is, grind it upon a hard and smooth stone with gum water, which must be made of two-third parts of gum arabic dissolved in so small a quantity of water as barely to cover the colour when the water is added and strained through a linen cloth, and one-third part of clear water mixed with the said gum so dissolved and strained. And with the gum water, thus made, temper your rose colour to a proper consistence, and use for whatever you please."

As a further example of the methods employed, the following receipt from a MS., not later than the middle of the fifteenth century, may be taken :—[1]

"*To make good and fine lake.*—Take 1 lb. of clippings of rosato, and put them into very strong ley made of ashes, such as the dyers use, in a new glazed jar, and set it on the fire to boil, and boil it slowly for the space of two paternosters; then pass the ley and the shavings through a clean linen strainer, and press it strongly with the hand, so that all the ley may pass out; then put back the ley to boil again

[1] This manuscript was found by Mrs Merrifield in the library of RR. Canonici Regolari Convent of S. Salvatore in Bologna.

without the clippings, and when it is boiled, throw it on the shavings which are in the strainer, and press the strainer hard with the hand, so that all the ley may run out, and put it by. Throw away the shavings and wash the strainer well, so that there may not remain in it any of the hairs of the shavings. Next take 5 ozs. of roche alum in fine powder, and put it, a little at a time, into the ley, until the ley begins to settle, which you may know by its turning almost entirely to a thick scum from top to bottom, and you must keep on mixing the ley with a clean spoon until it becomes cool and settles; then put the ley into the clean strainer and strain it all off, and the lake will remain on the strainer. Let it remain on the strainer until quite dry, and then put it into a small basin of glazed earth full of clear and cold water, and stir and rub it up well with the hand until it diffuses itself; all the scum which rises to the top at first must be thrown away with a feather; then wash the strainer well and pour into it the water in which you have put the lake, and the clear water will pass out along with the alum, and this is called purifying it from the alum. And when the lake is nearly dry, remove it from the strainer, and spread it out with a broad knife on a new tile. Let it dry in the shade, and before it has done drying, cut it

into pieces, according to your fancy, and let it dry, and it is done. And know that the more it is purified from the alum, the more beautiful, and lively, and the better it is. And observe this secret, that if you wish to have the lake a brighter colour and one which will never change, when the shavings are boiling, add a lump of assafetida as large as a chestnut."

These two receipts give in some detail the general methods in use during the fifteenth, sixteenth, and seventeenth centuries for the preparation of lakes. There are, however, certain variations in detail that are worth noting. The introduction of assafetida is not again suggested, but in a receipt of later date the substance is boiled with fennel seed. This receipt is worth quoting in full, as it shows that they were aware that under certain conditions the colour would carry down alumina without the addition of an alkali :—

"*To make a most beautiful purple lake.*—Take an ounce of fine grana or cochineal, a quarter of an ounce of roche alum, and about a boccale full of common water. Boil the water with a quarter of an ounce of fennel seed until it is diminished one-third; then add the grana or cochineal finely pulverised, and boil the whole over a slow fire for a quarter of an hour; then

add the pulverised roche alum, and let it boil for another quarter of an hour. After this, take it from the fire, strain it through a linen cloth into a new and unglazed earthen porringer, and leave it there for eight days. You must then decant the water, or take it up gently with a sponge, evaporating the little which remains, until the colour is condensed, which you must afterwards keep in shells, adding to it a little lemon juice."[1]

I have tested this receipt, and find that a precipitate is thrown down of a purple colour. The addition of lemon juice referred to here, and in some other receipts, causes the lake to become more of a crimson and less of a purple.

Occasionally lime is to be added to the ley, prepared from wood ashes, thus making it into caustic potash; and in one receipt we are told that the urine must be kept twenty days, then boiled, skimmed, and filtered. Occasionally lime-water alone is proposed instead of ley. Alum is usually called roche alum, but occasionally an alum zuccarino is mentioned. The addition of tartar is mentioned in a receipt in the Padua MS., and the addition of sal gemma, or pure rock salt, is once or twice referred to.

[1] From a MS. in the library of the University of Padua, date probably the middle of the seventeenth century.

Occasionally the addition of powdered travertine, egg shells, or fish-bones is advised; and directions are frequently given for filtering the ley through the wood ashes several times with a view to obtaining a saturated solution. In a receipt given by Alcherius, a little ley is added to the alum before adding the alum solution to the coloured liquid, thus preparing a basic salt. In more than one receipt the lake is to be strained through linen, after the addition of the alum. Apparently this would stop the pieces of dye-wood or the grana from passing through, while allowing the passage of the alumina. To understand this, we must remember the loose weaving of linen at that time. When the lake itself is to be filtered, a woollen bag is usually prescribed, shaped like the hood of a Capuchin friar. In some receipts we are told to dry the lake in the shade, and not in the sunlight, and occasionally the directions for filtering are omitted. The washing of the lake is hardly ever referred to.

In conclusion, we may sum up the methods used by saying that they consisted in boiling the dye-stuff with an alkaline solution, and precipitating the colouring matter with alum.

Passing from the methods of preparation, the substances usually used to prepare these lakes require

next to be considered. A very large number of substances seem to have been used at different times for the preparation not only of rose colours, but also of blue, green, and yellow lakes. For instance, Eastlake (p. 441, *Materials for a History of Oil-Painting*) mentions graines d'Avignon, weld, broom, curcuma, saffron, aloes, and the inner bark of various trees, as used for the preparation of yellow lakes. De Mayerne (1573–1655), a friend of Rubens, mentions a green lake prepared from buckthorn (*Rhamnus catharticus*), and Hoogstraten says, "With us lakes are in use, not only the purple, but the blue, green, brown, or tints of yellow lakes." These quotations are sufficient alone to show the large number of lakes in use at various periods in the history of art, and effectually dispose of those who imagine the old masters to have been confined to using a few colours only. Anyone who holds this view need only study the "Tabula de Vocabulis Sinonimis et Equivocis colorum," at the beginning of the MSS. of Jehan le Bègue, to abandon it at once. Nevertheless, though so many lakes were known, those of most importance seem to have been the rose-coloured lakes. I shall therefore pass over my experiments on lakes from broom and from saffron, and consider only the substances used for the preparation of rose-

coloured lakes, but I shall also include the preparation of lake from madder.

The rose-coloured lake prepared from ivy gum has already been considered. In the later receipts we find Indian lac, Brazil-wood, and kermes repeatedly referred to. I shall begin by considering the lakes prepared from Indian lac.

It is sometimes doubtful whether the word lac or lacca refers to the red resin from India, or to ivy-juice, which is occasionally called lac; but it is evidently the Indian resin in the later manuscripts, and we find that it was imported for dyeing into Spain and Provence as early as 1220. The colouring matter in this resin is due to the *coccus lacca*, which lives on the twigs of trees of the species Butea, Ficus, and Croton. These insects become embedded in the resin which exudes from the tree, thus forming a red resinous mass, which is imported under the name of stick lac, and probably corresponds to the substance known as Indian lac in olden times. It is customary now, however, to soften the resin in water, when it is removed from the tree, by which the colouring matter is largely extracted, and the resin known as shellac separated. The solution of the colouring matter is then evaporated down into cakes known as lac dye. Until quite recently

a considerable quantity of lac dye was sent into England, and I had some difficulty in obtaining a pound of it. The sample I obtained has been, I should think, overheated during evaporation, and the colour partly burnt. As showing the identity of stick lac with the Indian lac of olden times, I may mention that it is stated in the Padua MS. already referred to, that on separating the colouring matter, a colourless resin would be left behind, which could be used for making varnishes. I have prepared—(1) some of the lac dye ground with gum; (2) a lake prepared by boiling the lac dye with a solution of soda, filtering and precipitating filtrate with alum; (3) a lake prepared by boiling stick lac with soda, filtering and precipitating with alum. This lake may be considered to correspond closely to that used by the old masters.

Another substance largely used for preparing lakes is a dye-wood known as verzino, berxillium, brexillium, brasillium, and Brazil-wood. It has long been known as a dye-wood, being mentioned in the book of "Roots," by Rabbi David Kimchi, and was called by the Arabs *albakim* or *bacam* (*baḳḳam*). According to Marco Polo, the best quality grew in Ceylon. It was afterwards discovered in, and imported from, South America, and it has been sug-

gested that Brazil takes its name from the fact of this wood being found there. No wood of this name is now imported from the East, but similar dye-woods, known as Sapan-wood, Saunders-wood, and Buc-wood, are imported from the East, while the name Brazil-wood is confined to that sent from South America. The different dye-woods are all varieties of Cæsalpinia, and probably the dye-woods now sent from the East are the old verzino or brexillium. I have prepared a lake from Brazil-wood by boiling it with soda and then precipitating with alum. This is probably very similar to the lakes obtained from this wood by the old receipts.

As a rule, we expect to find that substances in favour with the old masters for the preparation of colours would yield permanent pigments; but this is not so in the case of Brazil-wood, all these dye-woods yielding fugitive dyes.

We shall have to consider the question of the use of fugitive lakes when we come to treat of the mediums with which the pigments were ground.

The most famous of all red dyes is that obtained from kermes, a small insect of the same genus as the cochineal insect, and known as the *coccus ilicis*, which is found on the prickly oak or ilex round the coasts of the Mediterranean, the best quality com-

ing from Arcadia. The female coccus is collected from the trees, and, as collected, looks like small scarlet berries, which crush to powder in the hand. The first mention of this dye occurs in the directions for the curtains of the Temple (Exodus xxvi. 1); and it seems to have been used from the earliest times for the production of a red dye. Professor Middleton has shown me some pieces of cloth from the tombs in Middle Egypt, dating from 300 A.D., which he believes to be dyed with kermes, and in which the colour is perfectly bright and fresh. It can be traced as a dye through the Middle Ages in the south of Europe. It was mentioned in a commercial agreement between Bologna and Ferrara in 1193; and Florence and Venice were famous for stuffs dyed with it in the fifteenth century.

The Italian name for the dye was *grana*, from which comes the English phrase "to dye in grain"; and Shakespeare has given his testimony to the permanency of the dye, when he makes Olivia say of her complexion, "'Tis in grain, sir; 'twill endure wind and weather."

Hellot, in his *L'Art de Teinture* (1701), pp. 244 and 264, says that the figures in the old Brussels tapestries, two hundred years old, and dyed with this substance, are perfectly fresh; and Berthollet states

the dye to be quite permanent, in his work on dyeing. It continued to be used till the introduction of cochineal from America in the sixteenth century, by which it was gradually replaced. Apparently Cortes first sent reports of the cochineal insect to Europe in 1523, and we find that Matthioli mentions it as quite common in 1549; and in the Padua MS. already referred to a receipt for lake is given, in which either grana or cochineal is advised to be used, showing that at that time cochineal had partly, but not entirely, replaced kermes. It is still used in Persia as a dye, but is no longer an article of commerce. The samples I have obtained were given me by the late William Morris, who imported it for dyeing his finest reds for tapestry weaving. Lake prepared from it was known as *lacca di cimatura di grana da rosato*, and was almost always prepared from the clippings of the cloth dyed with kermes. In the receipt quoted we are directed to take these clippings, which apparently were the loose pieces of wool trimmed off the cloth before it left the dyer's hands, and could apparently be obtained by the painters in sufficient quantity from the dyers. I therefore asked Mr Morris to dye a piece of cloth for me with kermes, in order that I might test this method of preparing the lake.

The process of dyeing it was very simple. The cloth being mordanted with alum containing a little tartar, and then dyed in a water solution of the kermes, the whole of the kermes was absorbed by the cloth. I have boiled a piece of this cloth with soda, strained off the solution, and precipitated it with alum. The lake thus prepared does not differ appreciably from the lakes prepared from kermes direct.

The first receipt for the preparation of the lake directly from kermes that we find occurs in the *L'Arte Vetraria*, by Neri (1612). This book, though mainly confined to the preparation of colours for staining glass, contains some receipts in the seventh book for the preparation of lakes, and in chapter xix. Neri states that, finding in Pisa "non occorre Cimatura, non Maestra," he prepared kermes lake by boiling the kermes with a solution of alum, allowing it to stand for some days, and filtering. I find that if kermes is boiled with alum in this way, and allowed to stand, the precipitate of a rose-coloured lake is gradually formed. Some receipts also occur in the Padua MS. for the preparation of a lake direct from kermes. I have made a lake prepared by boiling kermes with soda, filtering, and precipitating with alum.

As already stated, few references to lakes prepared from madder occur. It was largely used for dyeing, and was therefore probably used for the preparation of lakes. Besides references to it in the MSS. of Eraclius and Petrus de S. Audemar, Theophilus refers to a substance called "menesch," which seems to be a corruption of the Indian name of the root *mnitsch*; and Neri gives a madder lake receipt in the *L'Arte Vetraria*, book vii., chapter cxviii.

It is hardly necessary to collect examples for its use as a dye, but, in passing, we may mention that some of the cloth from the Egyptian tombs, already referred to, is evidently dyed with madder, the colour being perfectly preserved. It is mentioned in the statutes of Marseilles (1287), its cultivation was much encouraged by the Emperor Charles V. in Holland, and the curious regulations as to its use by the greater dyers only, show in how much esteem it was held.

In my experiments on madder lakes, I have made use of the preparation known as alizarin.

In conclusion, I would like to point out that, with the exception of madder, the lakes described are all very similar in tone of colour. I have described them as rose-coloured lakes, translating by this word the words *roseli*, *roxita*, *roxeum*, *roxaceum*,

roseo, *rosa*, and so on. A receipt given in the Padua MS. helps us to settle what was meant by the description "rose-coloured," and to confirm my belief that the lakes I have made closely resemble those made during the best period of art. The receipt is as follows :—

"*To make Brazil-wood of four colours.*—Take Brazil-wood, and steep any quantity you please (so that it is more than a third part) in clear water, until the colour is very red (*rosso*). Then divide this colour into four parts. If you wish to make a rose colour (*rosato*), use it pure ; if you wish it purple (*pavonazzo*), use lime-water, but the water must be tepid ; if you wish a violet colour (*violato*), add a ley to it ; and if you desire that it should be of a mulberry colour (*morello*), add tartar."

I have stained (1) a piece of paper with Brazil-wood water, and therefore the rosato colour, which is a purplish red ; (2) a piece of paper stained with Brazil-wood water, rendered alkaline with soda, and therefore of the violato colour.

Even if we include madder amongst the lakes they used, they had evidently nothing which corresponded in tint to the cochineal lakes, or so-coloured madder lakes used by modern artists. This, doubtless, accounts for the fact which I have been told by ex-

perts, that modern lakes cannot be used in copying the old masters.

It may be asked how the magnificent reds were produced by means of these lakes. The following quotation from the Padua MS. throws some light upon this :—

"7. *The mixtures of cinnabar.*—The colour of ripe strawberries is imitated with cinnabar and lake. Scarlet is made (*scarlato*) with cinnabar, lake, and white lead. Blood colour is made with cinnabar and lake. The red colour on the cheeks of beautiful flesh is represented with cinnabar, lake, and white lead."

I have tried some experiments on this point, and find that very rich crimsons can be obtained by glazing one of these rather dull purple-coloured lakes over vermilion, and many rich robes in the pictures at the National Gallery can be matched in this way, though they are usually somewhat browner in tone. An interesting example of a figure just ready for such glazing is the St John in the *Entombment of Christ* (790), apparently painted in red lead.

Examples of the purple lakes themselves can also be found in many pictures, and in various states of preservation ; some very bright (see angel's robe

in the Botticelli, 275), some very much faded (see the Roger Van der Weyden, 664).

The combined red produced by glazing the lake over vermilion is less likely to alter seriously with time, because the dulling of the lake is compensated for by the fading of the lake, and therefore the shining through of the vermilion. I have found, for instance, that even Brazil-wood lake, used in this way, produced a fairly durable red.

With reference to the permanence or otherwise of the lakes described above, Brazil-wood fades in a few weeks, or on exposure in a south window; lac lake is half gone in a couple of months; kermes is considerably faded in twelve months; while under the same tests madders are unchanged. None, therefore, of these old lakes can be recommended for reintroduction; but if a lake is required for glazing vermilion, some shades of purple madders are probably better than even kermes.

It is evident from this inquiry that while these lakes may have been suitable for illuminating books, they were not suitable for pictures to be exposed to the light; and while, as has already been explained, in many cases they have faded, and in other cases the magnificent deep rich reds consist of a faded lake over vermilion or red lead, yet there are many other

cases where the pure lake has stood perfectly, not only in oil, but also in tempera. It is difficult, therefore, to resist the conclusion that these were madder lakes, in spite of the fact that receipts for madder lakes are almost entirely absent. There are two possible explanations. One is, that even in Cennino Cennini's time lakes were manufactured and purchased by the painter, and in fact Cennino Cennini advises the painter to purchase his lake, and in addition gives him the bad advice to buy a lake made from lac, if by this the Indian lac is meant; and therefore trade processes of making lakes from madder may have been known which do not appear in the monk's receipts. The other explanation is that in many cases the red cloth clippings used may have been originally dyed with madder, and so a very pure madder lake would be obtained. In fact, it is difficult to make a fine-coloured lake from the madder root direct, and it would be better for the unskilled worker to use the dyed cloth as the source of his alizarin or madder extract. There is also the uninvestigated but unlikely possibility that the ivy gum lake is permanent. On the whole, I think we must conclude that a lake from madder was often used, though possibly unknowingly.

We shall also find on investigating the properties

of varnishes that there are methods in oil-painting of rendering fugitive lakes permanent; but this is not sufficient to explain their fine state of preservation in tempera pictures, or *in some cases* on illuminated MSS. which have been ruthlessly exposed to light in our modern museums.

CHAPTER XIII

ON THE NATURE AND HISTORY OF VARNISHES, WITH SOME INTRODUCTORY REMARKS ON THE HISTORY OF THE OIL MEDIUM

With the treatise written by Cennino Cennini we bring to a conclusion the description of the methods of painting in tempera, and must now proceed to an inquiry into the processes adopted by the artists who painted in oil. Tempera, it is true, continued in Italy for some time after Cennino Cennini wrote his treatise; but at the very time he was engaged in writing, the brothers Van Eyck in Flanders were preparing the way for a complete revolution in the methods and mediums employed by artists.

It is true, as we have already seen, that the oil medium had long been known, but it was now to assert its superiority over the egg medium and carry all before it. The consideration, however, of the

period covered by the sixteenth and seventeenth centuries must be preceded by a careful inquiry into the earlier methods of oil-painters. Unfortunately for this earlier and, from our point of view, most interesting technique, there is little information, as most of the writers we possess, such as Vasari, Borghini, Armenini, and others, belong to the middle or the close of the sixteenth century, or to the seventeenth century, while the most interesting of all, De Mayerne, wrote in the beginning of the seventeenth century. Nor do such MSS. of "Secreti" as exist help us very much. At each period, however, that we have dealt with, we have had some documentary evidence of supreme importance to guide our inquiry. The classical period is fitly closed by the writings of Pliny; the mediæval period is fully illustrated by the monk Theophilus; and the close of the fourteenth century and opening of the fifteenth century in Italy, and more especially the finished product of tempera-painting, is fully treated by Cennino Cennini. In the same way the technical methods at the close of the sixteenth century and beginning of the seventeenth century, at any rate in the Flemish school, are most fully dealt with in the interesting MS. left by De Mayerne. De Mayerne himself was born in 1573 at Geneva, and was trained for medicine in Mont-

pelier and Paris, and was appointed one of the physicians-in-ordinary to Henry IV. In 1611, James I. invited him to England, and appointed him his first physician. De Mayerne enjoyed the same title under Charles I. He died in Chelsea in 1655, leaving a large fortune. He was a distinguished chemist, and took a special interest in the technical processes and materials used in painting, and was in close friendship with the painters of the Flemish and British schools. His portrait was painted by Rubens. One MS. which he left behind him consists of notes in his own hand, communications from various artists, and short treatises, and the whole is entitled, "Pictoria, Sculptoria, Tinctoria, at quae subalternarum Artium spectantia; in lingua Latina, Gallica, Italica, Germanica conscripta, a Petro Paulo Rubens, Van Dyke, Somers, Greenberry, Janson, etc." The whole has been recently printed and translated by Herr Berger in the third volume of his *Beiträge zur Entwickelungsgeschichte der Maltechnik.*

It is full of interesting information. We find De Mayerne, for instance, trying to persuade Van Dyck to mix his pigments with a special varnish of his own composition, but evidently Van Dyck cannot be bothered with it, as it does not work freely enough under the brush. Again, speaking of real ultramarine, for the

preparation of which he gives receipts with which we are already familiar, he tells us that : "The vertues of it. It is the diamound of all colours by reason of his never-fadinge perfectione. It also comforteth the brayne, and therefore is very proffitable agaynst frensies, vertigo, palpitatio cordis, melancholia, and other sicknesses of the spirits." In many cases he comments in his marginal notes on receipts given by artists, giving the results of his own experiments. The consideration, therefore, of the De Mayerne manuscript, with some additional information from other and later writers and MSS., will guide us in the concluding portion of the chapters on varnishes and on oil-painting. We shall, however, begin by considering the early history both of varnishes and oil, and shall now proceed to the discussion of the nature and history of varnishes.

In the chapters on Egypt and on classical methods of painting, some account was given of the preparation of varnishes, and a distinction was drawn between what is known as a spirit varnish and an oil varnish ; and it was also pointed out that we have in the natural balsams from the tree a natural spirit varnish containing volatile oils, which evaporate and leave the resin behind. It is necessary now to consider the whole question of varnishes more carefully

with a view to trying to get some light upon the methods used by Van Eyck and his school in protecting the pigments upon the surface of the picture. In the first place, it is not every resin that can be used for making a spirit varnish, because many of the harder resins are not readily soluble, amber, for instance, dissolving very little indeed in these mediums. It is usually the custom at the present day to select the harder resins for the making of oil varnishes, and the process consists of, in the first place, fusing the resin and then mixing with the resin the hot oil. The whole mass is then reheated until a drop of the varnish drawn from the heated mass remains practically clear. It is also necessary to introduce "driers" into the varnish, such as the oxides of lead or other compounds of lead or manganese. The properties of these driers will be discussed in the chapters on oil-painting. The varnish is finally diluted with spirits of turpentine. In the case of some of the softer resins, such as the pine resins, and mastic and sandarac, there is no need to fuse the resin first ; they can be dissolved directly in the oil without previous fusion. When we come to the consideration of the receipts for varnish-making which are found scattered through the old manuscripts, from the Lucca Manuscript onwards, one of

the first difficulties that we find is in identifying the resins that were used. It is, at the present day, sufficiently difficult to identify the source from which a given resin comes, and there can be no doubt that in ancient times great confusion existed on this subject. It is, therefore, a waste of ingenuity to try to settle exactly what resin was used in a given receipt from the name given to the resin, and to determine whether it was mastic, or sandarac, or amber. At the same time, we have an approximate idea what resins were available for varnish-making. In the first place, they had the natural balsams from the pine, such as Venice turpentine from the larch and oleo de abezzo from the silver pine; and in addition they had the resin known as pica greca or gloriat, which corresponds to our modern rosin, and is left as a solid residue on heating the pine balsam and driving off the spirits of turpentine. They also had both mastic and sandarac—sandarac which has sometimes been mistakenly called juniper resin, but which is really a product of the *Callitris quadrivalvis*, and is found on the Mediterranean coast of Africa, and apparently was at one time exported in considerable quantities from the port of Berenice (now Benghazi) on the African coast (not to be confounded with the other Berenice on the Red Sea).

It has been said, in fact, that the name "varnish" comes from the fact that sandarac was exported from here. We know that mastic and probably other resins found in the East were exported to Europe, and that no very clear distinction was drawn by the varnish-makers of the day between one resin and another. In addition, amber was known and obtained from the Baltic, and it is quite possible that at any rate occasional parcels of resins from further east came into the European market. If we make experiments, then, upon these resins, we find that pica greca, mastic, and sandarac can be dissolved directly in hot linseed oil, but amber requires first to be fused and then the boiling oil added to it. In addition, we find that the amber forms a very dark varnish indeed, quite unsuitable for painting, unless mixed with the very darkest colours; it also dries very slowly, and is apt to run upon the picture. In fact, of all the varnishes it is perhaps the most unsuitable for painters' use. Many receipts have been suggested for making pale amber varnish, and processes for dissolving at any rate part of the resin from the amber and so utilising it; but so far as my experience goes, these processes are very difficult and troublesome, and in many cases the paleness of the varnish is due to the fact that there is little or

no amber in it. I am aware that there are varnishes on the market which claim to be made of amber, and which are pale in colour; but I am not aware of the methods of manufacture used, and while it is perhaps possible with the resources of modern chemistry to make a pale amber varnish, it is highly improbable that such a varnish could be prepared in early times, nor, judging by the receipts which are given in the manuscripts, and which I have tried, would any such pale varnish result. It is also highly probable that the name "amber varnish" was given to trade varnishes which had really no amber in them, as it was an obvious and pleasant name to give, amber being well known as a beautiful substance, and the varnish resembling it in appearance and colour. If, then, we find a receipt for dissolving the resin directly in oil, we may assume that the resin was either pica greca or mastic, or possibly sandarac; but the harder resins are excluded, from the very nature of the receipt. The probabilities are that in most cases the softer resins were used. The next point to notice is that in many of these receipts the proportion of resin to gum is very high indeed. This indicates the use of one of the softer resins. For instance, it is common to find that to three parts of oil one of sandarac is to be added

and two parts of pica greca, thus forming a mixture which is as much resin as oil. Such varnishes would be very thick, and would require to be thinned by means of oil or some other medium before they could be used, or rubbed on hot. If, however, mastic and pica greca were the resins selected, they would be quite pale in colour; and even a varnish which is nearly solid from excess of sandarac is not very dark, and could be used, if diluted. Such receipts are repeated so often that I think there can be no doubt that the ordinary varnish used from the ninth till late in the fifteenth century consisted of a fairly soluble resin—sandarac or mastic, or both, dissolved in linseed oil, and with the addition, in many cases, of a considerable quantity of pica greca. We also find, however, several receipts in which the pine balsams are directly used, mixed with oil. A considerable variety of receipts can easily be quoted, making it a matter of doubt as to what kind of varnish was used in practice. In trying, therefore, to arrive at some conclusion as to what would be the best varnish for the painter to select in the wish to preserve his picture, we must carry out experiments on the properties of varnishes. We shall then be in a better position to discuss actual receipts.

First, we ask what varnish would prove the most

durable under the test of time? In the second place, we have to ask the question, what varnish would best protect the pigments from the action of air and moisture? To deal for the moment with the question of durability, modern experience is in favour of the conclusion that the most durable varnishes are those formed from the hardest resins dissolved in linseed oil. For instance, the varnishes which are prepared for carriage-building, and more especially for the outsides of railway carriages, are prepared from the hardest copal or kauri resin, fused, and then dissolved in the hot oil. These resins may be considered nearly as hard as amber, and, in fact, it is a question whether the varnishes prepared from them are not more durable than an amber varnish. They also have the advantage of being lighter in colour. There can be no doubt as to the greater durability of the hard resins, such as copal or amber, dissolved in oil. Next to these in durability come varnishes prepared with soft resins dissolved in oil; while the most easily injured of all are the spirit varnishes, where the resin has got no elastic oil mixed with it. In order to bring this matter to an exact test, I carried out a series of experiments to see at what point the surface of a thoroughly dried varnish would break when painted upon glass and

then subjected to a scratching pressure from a blunt steel point. The following figures give the results of these tests, the pressure being measured in grammes :—Varnishes made with common rosin and linseed oil, and therefore corresponding to old receipts, where pica greca alone was used, broke down under a pressure of 250 grammes. Ordinary indoor floor and "oak" varnishes, suitable for woodwork, but not made from the hardest resins, broke down at 500 to 600 grammes; while varnishes made from hard African copals and selected kauri (from New Zealand) broke down at from 900 to 1200 grammes.

In contrast to these, spirit varnishes and linseed oil itself break down with a pressure of 100 grammes, the one splitting up like glass, the other tearing. If such varnishes as these are allowed to weather out of doors, the varnishes from the hard resins prove the most durable. The only trade "amber" varnish I tested broke down at 100 grammes.

It is evident, then, that the modern hard copal varnishes are much the most durable, and would under severe tests long outlive the varnishes made according to most of the old receipts, which have already been briefly referred to. It does not, however, therefore follow that these old varnishes

were not durable enough for the purposes of the artist.

We have seen, for instance, that a pure resin varnish of 1500 B.C., made from a soft resin readily soluble in alcohol, continues to be fresh and bright although the wood of the coffin is crumbling to powder. This varnish has of course been preserved under peculiarly favourable conditions; but there is at any rate no evidence that a varnish of oil and resin or pica greca is not practically indestructible under favourable conditions, such as when used on a picture to be preserved with care from injury and exposure to weather. The severe tests to which modern varnishes are exposed throw no light on this question.

I am personally disposed to think, though I know some leading authorities will not agree with me, that just as linseed oil alone has proved remarkably durable, so linseed oil loaded merely with common rosin will prove even more durable under proper conditions, such as when laid on a picture panel, and, while probably becoming covered with fine cracks, will not necessarily decay further. The matter, however, requires further investigation.

There is, of course, also another possibility, and that is, that varnishes made from hard African co-

pals were not unknown. Receipts are given which indicate the use of a hard resin—that is, the resin is first to be fused and the oil added; and it has usually been assumed that these receipts are for amber varnish, as the recognised names for amber, such as glassa and karabe, are used. It is, however, quite possible that hard copal was not clearly distinguished from amber, and that in many cases it may have come in from the East and been used for varnish-making. In fact, it might be suggested that the perfect preservation of pictures at certain periods may have been due to the accidental use of this resin for varnish-making. We shall, however, have next to consider varnishes from another point of view, an inquiry which will on the whole bring us back to the view that soft resins were from the beginning largely and freely used in painting what, for want of a better name, we call "oil-pictures." Our inquiry will be into the question of the extent to which oils and varnishes prepared in various ways will protect pigments from moisture and injurious gases. In order to settle this it is necessary to use a substance very sensitive to the presence of moisture and changing in a marked way when absorbing it.

The two oils used by the old masters were linseed

and walnut oil, and later on poppy-seed oil. As already stated, besides these oils, the materials for making varnishes were mastic, sandarac, amber, the balsam of the silver pine, or oleo de abezzo, the balsam of the larch, and possibly other Eastern gums. I shall not trouble you with all the learned discussions as to the nature of the varnishes used. Receipts exist in plenty, and show that in the earlier varnishes these substances are dissolved in oil. Later on, in the sixteenth and seventeenth centuries, spirit varnishes were introduced—that is, the resins were dissolved in turpentine or natural naphtha. The main distinction between modern varnishes and the ancient varnishes is the abandonment of amber, sandarac, and pine balsams, and resins, for the gums of the East. The peculiar properties of balsams will be explained in the course of this chapter. I may say that what now follows is an investigation into the capacity of various oils and varnishes of resisting moisture, which brings us to some curious and, I venture to think, new conclusions.

When we look at the Van Eyck, No. 186 in the National Gallery, we are at once struck with its wonderful state of preservation. The reds, probably produced by glazings of lac, or Brazil-wood, or kermes lake, over a yellow or red ground, seem certainly

to have slightly faded and turned brown, when compared with fresh preparations of the same lakes made from the old receipts; but they are in a very fair condition, and the green on the wife's dress is marvellously brilliant. This green is worthy of special attention, as it seems to be agreed, among the authorities on these matters, that it can only have been produced by a glazing of verdigris, a pigment which we now know to be of a most dangerous character, turning black, and corroding and destroying other colours. The oranges in the corner are apparently painted with orpiment, another dangerous colour to use.

With reference to the reds, I have already mentioned the three lakes which are most commonly referred to in old receipts, madder being hardly ever mentioned. Of these, Brazil-wood is very fugitive, turning a dirty brownish-red, and fading very much, if only exposed to sunshine for a few days. Lac lake, though better than the last, is not a permanent lake, and kermes, though better than lac, is not a permanent lake. Unfortunately, these lakes, when prepared from the old receipts, are so much alike that it is impossible to identify them on a picture. Judging, however, by these receipts, one lake is as likely to have been used as another.

In this picture, then, painted early in the fifteenth century, we probably have verdigris, a notoriously fugitive pigment; orpiment, a pigment very apt to change; and a lake which will fade with more or less rapidity, according to which of the three lakes above-mentioned has been used.

It cannot, then, be held that the preservation of the picture is due to the pigments used, and we must therefore look elsewhere for an explanation of its freshness.

If, then, the secret does not lie in the pigments, it must be in the vehicle, and this leads us to consider what properties a vehicle must have to produce so remarkable an effect.

This question is very easily answered.

It has been again demonstrated by Professor Russell and Captain Abney, in their report on water-colours (1888), that most fugitive pigments are permanent if protected from moisture, and a still larger number if protected both from air and moisture. If, then, we can obtain a vehicle which will really protect the particles of the pigment from moisture, we may use with safety many pigments that are now regarded as fugitive.

At this point one is apt to think that the inquiry is concluded, as we are accustomed to assume that

ordinary varnishes and oils do preserve surfaces from the action of moisture; but, unfortunately, if a sufficiently delicate test is applied, this is not found to be so. The method I have devised for doing this is to use as a pigment ignited sulphate of copper, which is of course a very hygroscopic body. If we grind a little of the ignited sulphate with linseed oil, and paint it out on a glass slide, we get an enamel-like white surface, with sometimes a slight greenish tinge in it.

If this is placed in a desiccator to dry, it remains the same in appearance. If, however, when dry it is exposed to the air of a room, it gradually turns green and transparent; or, if it is exposed under a bell-jar, beside a dish of water, the change takes place much more rapidly, twelve hours being often sufficient. If we now examine the slide under a microscope, we usually find that no definite crystalline formation is visible; but occasionally, here and there, are to be found complete crystals of sulphate of copper, due apparently to a slow aggregation of molecules in the colloid linseed oil.

I shall begin by describing the experiments I have made on linseed oil alone.

The linseed oil of modern commerce differs in several important particulars from that used by the

old masters. Hot-pressed from the seed, and refined by the addition of sulphuric acid, it is probably an inferior product. The oil of the old masters seems to have been cold-pressed, or pressed after having been slightly warmed, from pure seed, and then refined by exposure to sunlight and washing with water.

In converting it into boiled oil, various substances and methods were used, such as exposure merely to the sun till it thickened; boiling with bone ashes and pumice; boiling it with ignited sulphate of zinc;[1] boiling it with litharge or with white lead, or with umber; or exposing it to the sun in leaden dishes, or mixed with white lead.

The modern practice is probably in many cases similar, salts of manganese having been added to the list, and such substances as sulphate of zinc having been abandoned.

My impression from the study of the old receipts is that probably in most cases litharge, or white lead, was used, just as it is most commonly used now. We have, then, to look rather to the earlier stages of the preparation of the oil, to find any serious difference between ancient and modern practices.

[1] The use of this substance is probably accounted for by the fact that the crude sulphate prepared from the ore often contains manganese. The pure sulphate has no effect on the oil.

With a view to finding whether the capacity of linseed oil for resisting moisture would be improved by following any of the old methods, I tried the following experiments. I obtained—

1. A sample of ordinary pale drying oil of the best quality.

2. A bottle of drying oil from one of the leading firms of artists' colourmen.

3. A sample of Bell's medium from Messrs Bell & Co., of Oxford Street. This medium is prepared by cold-pressing carefully sifted seed, and then keeping the raw oil at a temperature of about 100° C. for some weeks, until it becomes thick and viscous. This "fat oil" is then thinned with oil of spike for use.

4. I obtained some raw oil, cold-pressed from sifted English seed, which I then refined in the following manner:—A bottle was filled one-third full with salt water and sand, and one-third full of oil, and was placed in the sun, with a loose cap over the top, for four weeks. By the end of that time no more precipitate was formed, and the oil was drawn off, filtered, and converted into boiled oil by heating to 100° C. for 120 hours with borate of manganese.

Another portion, after refining, was converted into boiled oil, by heating strongly for three hours with bone ashes, adding ignited sulphate of zinc,

and allowing it to settle and stand in the sun, according to an old German receipt which is quoted by Eastlake in his *History of Oil-Painting*. Slides were painted out with these different oils mixed with sulphate of copper, and after having been dried in a desiccator were exposed to moisture. They all turned green at approximately the same rate, and repeated experiments did not show that one had much advantage over another. If a slide is varnished with oil after being dry, it of course resists a little longer; but four layers of such varnishing only protect the slide for three days instead of one.

As far, then, as these experiments are concerned, there seems to be no reason to suppose that the pure oil, sun-refined, has much advantage over the commercial oil, or that the different methods of converting it into boiled oil exercise an appreciable effect. Only one point seemed to remain unsettled. It seemed possible that the old oil, imperfectly pressed, might be superior to that obtained by the hydraulic press. In order to test this, I had some fresh seed pressed, and took samples during the pressing, dividing the oil into three parts. Taking the first of these, I refined it, boiled it with borate of manganese, and tested it. The moisture penetrated through it as before.

These experiments seem to show, then, pretty conclusively that linseed oil, no matter how pure, or how carefully refined, or in what way it is converted into boiled oil, cannot be depended upon to protect a surface from moisture. In the course of these experiments I was struck with the fact that linseed oil which had been kept for some time, after it was dry in the desiccator, seemed to resist better than lately dried oil, when exposed to moisture. Three weeks was found to make a considerable improvement, and two months still further improvement.

When we consider the nature and constitution of linseed oil, I do not think we need be surprised at its permeability to moisture. Besides containing linolein, it also contains considerable quantities of non-drying fatty acids, which, being unaltered during the oxidation of the linolein, must tend to produce a spongy and porous surface. According to Allen, the dried film contains free glycerine, which must not only tend to increase its porosity, but also to act as a carrier of moisture. Taking these different facts into consideration, the passage of moisture through linseed oil is not surprising.

I should like to refer here to a theory which has been recently advanced, that lead driers are injuri-

ous in pictures, on account of the formation of lead soaps. As far as these experiments are concerned, we have no confirmation of this; and I confess that the theory seems to me a very startling one, in the light of the fact that the white lead used by the old masters was prepared by the Dutch process, and therefore contained large quantities of lead hydrate, and of the fact that the oldest receipt I am familiar with for preparing drying oil advises that this should be done by boiling with oxide of lead.

It seems to me more probable that treatment with lead salts may remove some of the fatty acids other than linoleic acid as lead soaps. I do not find, however, that the oil which rises to the surface of ground white lead protects from moisture any better than ordinary oil.

Walnut Oil

Walnut oil is frequently referred to in the old receipts, and seems to have been largely used by the old masters for painting. It can be prepared by pressing the kernels of walnuts after slightly warming them. The walnuts should be about three months old. The oil obtained is very pale, and dissolves white lead freely on boiling, becoming darker in colour. I prepared a little by boiling the kernels of

the walnuts with water, after pounding them in a mortar, roughly separating the oil which rose to the top, dissolving the oil in ether, filtering, and evaporating off the ether. I then converted this oil into a boiled oil by heating it with white lead. On testing it with the sulphate of copper, I found that moisture rapidly penetrated, showing that it is no better in this respect than linseed oil. As these were the two oils which were used by the old masters, the protection of their pigments cannot have depended upon the nature of the oil used.

Resins

In order to test how far pure resins will protect the sulphate of copper from moisture, I dissolved them either in spirits of turpentine or in benzol, ground the sulphate of copper with the solution, and painted it out on a glass slide. I have not attempted an exhaustive examination of resins, but have contented myself with a few typical ones, namely, colophony, mastic, Sierra Leone copal, and amber. The varnishes were all prepared by first fusing the resin, and then gradually adding the spirits of turpentine to the fused mass.

The change of appearance on exposing one of the slides thus prepared to moisture was quite different

from the appearance in the case of oil. The surface became an opaque greenish blue in the course of a few hours in the case of colophony, mastic, and Sierra Leone copal, but after that there was no further change. On then examining these slides under the microscope this appearance was explained. The whole surface was rough and covered with blue cones of sulphate of copper, with unaltered white plains between. Apparently the varnish on drying became full of small cracks or holes, through which moisture penetrated, but in itself resisted the passage of moisture. These holes were so close together as to give the whole surface a blue appearance when examined with the naked eye. The one exception to this was the amber varnish. It resisted the attacks of moisture for weeks without change. I think, however, that we may consider that such solutions of resins protect a surface from moisture sufficiently well for all practical purposes. The slight change taking place in the sulphate of copper does not go any further, and would, I think, be imperceptible in the case of a fugitive pigment.

I need hardly point out, however, that such solutions are quite unfit to be used as mediums in place of oil, and that the surface formed is brittle and not very durable.

Oleoresinous Vehicles

Eastlake, in his *History of Oil-Painting*, devotes himself principally to trying to determine what medium was used by Van Eyck and his immediate followers. As his book is the most important work on this subject, and he has devoted immense pains to investigating all the documentary evidence, the theory he advances requires specially careful examination.

Briefly, his theory is this, that the Flemish painters ground their colours in oil, that they prepared a varnish by dissolving a resin, preferably amber, in oil, and that they mixed a little of this with the colour. He claims that such a medium protects the pigments from moisture, and that it is only necessary in the case of specially fugitive pigments, such as yellow lake, verdigris, etc., to increase the proportion of varnish and diminish the proportion of oil, in order to effectually lock them up and protect them from the action of a moist climate. This he calls the oleoresinous vehicle; and while this in all probability represents their usual practice for ordinary pigments, I think he fails to make out that they relied upon this method in the case of notoriously fugitive pigments. In fact, as far as the sixteenth and seven-

teenth centuries are concerned, the evidence points to the use of a pure oil vehicle.

It has been shown by Professor Church that even so hard a resin as copal, when dissolved in a volatile medium, after a year becomes covered with minute cracks; that this is also true of copal dissolved in the usual quantity of oil necessary to make a varnish. But he finds that if a copal oil varnish is mixed with a certain proportion of oil, it forms a surface which is hard, and therefore preferable to oil alone, which is soft, but which does not crack. There seems to be no doubt, therefore, that, apart from other considerations, the mixture of a resin dissolved in oil, with oil, produces the most permanent surface. It remains to be seen whether such a medium has the quality claimed for it by Eastlake of protecting the pigments from moisture.

In order to experiment upon this matter, I obtained (1) a very fine sample of a genuine copal varnish from Messrs Freeman; (2) Mander Brothers, Coburg varnish; (3) I dissolved Sierra Leone copal in my own pure linseed oil, and heated it till it became stringy, as directed in the old receipts; (4) I dissolved amber in the same way in the pure oil; (5) I boiled some of the amber varnish, mixed with white lead till almost solid, and then diluted it with

spirits of turpentine. I then prepared slides with these varnishes mixed with the sulphate of copper. I compared the slides painted with pure oil with slides painted with a mixture of oil and varnish, and with slides painted with the varnish alone. In some cases the slides, after drying, were varnished with the mixture that had been used in painting them out. In making these varnishes, I mixed about one-third resin with about two-thirds oil. None of these preparations resisted the attacks of moisture. Those containing varnish resisted a little longer than those merely containing oil; but the difference was probably due to the greater thickness of the protecting layer.

As far, then, as we can judge by the sulphate of copper test, Eastlake's theory that an oleoresinous vehicle will protect a fugitive pigment is not correct. It seemed to me necessary, however, to check these results by some experiments made in another way, and I therefore determined to try whether such mediums would protect a fugitive pigment.

In order to reproduce, as near as possible, the conditions necessary in the case of one of the old masters, I prepared some Brazil-wood lake according to one of the old receipts, and, after careful washing and drying, ground it with the following mediums:—

1. Commercial pale boiled oil.
2. Rowney's boiled oil.
3. My pure oil.
4. The pure oil mixed with amber varnish.
5. The pure oil mixed with copal varnish.

All of these faded when exposed to sunlight, and apparently faded at the same rate.

To confirm this result, I next rubbed out on two glass plates carmine ground in pure oil. After the two plates were dry, I put one away in the dark and exposed the other to light. At the same time, I rubbed out on two other plates carmine ground with pure oil and a little amber varnish, and exposed one of these to light. The two plates kept in the dark retained their brilliancy, while the two exposed to light quickly turned brown at the same rate.

I think that these experiments show pretty conclusively that whatever method may have been used to preserve fugitive pigments by the old masters, it cannot have been that of grinding colours with oil, and then mixing in a little oil varnish, as supposed by Eastlake.

In order, then, to solve this problem as to the nature of the vehicle used to preserve fugitive colours, it is necessary to lay aside the theories of such writers as Eastlake, and examine carefully such old

receipts as are available. This is all the more necessary as the word varnish is used so carelessly by writers on this subject, for they seem to think that all varnishes have similar properties, and therefore it does not matter whether the nature of the varnish is stated or not. To begin with the oldest receipts, we find the varnishes there mentioned are all oil varnishes. Besides oil, they contain amber, or sandarac, and Pice Greca (rosin), and later on balsams, such as Venice turpentine, or oleo de abezzo (the balsam of the silver pine). Very large quantities of these balsams were sometimes used. For instance, in one old receipt a varnish is recommended consisting of three parts Venice turpentine, three parts of oil, and one part of mastic; while in another receipt two parts of Venice turpentine to one part of oil is given. Such varnishes must be considered simply as balsams, slightly diluted with oil to make them flow better and give greater toughness to the surface. The receipts for these varnishes will be considered in greater detail later on.

Apparently the first spirit varnishes, by which I mean in this case varnishes formed by dissolving a resin or a balsam, or both, in spirits of turpentine or natural naphtha, were invented in Italy, and thence found their way back to Flanders, the first home of

oil-painting; but they are not mentioned till the sixteenth century, and the records that have been left of the methods used by Van Eyck and his followers are so scanty, that we cannot speak with certainty on this point.

The first scientific account that we get of the methods of the Flemish painters is that given by De Mayerne, referred to already as our best authority, a friend of Rubens and Van Dyck. In the receipts given by him, Venice turpentine is frequently mentioned as a suitable substance for the preparation of varnishes, and he advises that it should be dissolved either in naphtha or spirits of turpentine, with the occasional addition of mastic, or with the addition of a few drops of oil to give it toughness.

Perhaps the most interesting of his receipts is the one in which he tells how verdigris can be prepared by dissolving it in Venice turpentine and spirits of turpentine.

The Italian painters seem to have preferred oleo de abezzo, as lighter in colour and quicker in drying; and in one of the receipts given in the Paduan MS. (seventeenth century) it is stated that amber can be dissolved in such a balsam. Apparently, in the time of Rubens, the custom had grown up in Flanders of varnishing pictures after they were

finished, which was not done in the days of Van Eyck. Doubtless, therefore, the varnishes mentioned by De Mayerne are meant for covering finished pictures, and the receipt for preparing verdigris is not apparently for painting purposes. To carry down the tradition as to the use of Venice turpentine, it is only necessary to refer to the canvas of Sir Joshua Reynolds, in the possession of the Royal Academy, where the dab of paint labelled gamboge, plus Venice turpentine, is perfectly fresh, while the dab labelled gamboge, plus oil, has completely faded. Sufficient has been said to show the necessity of investigating the properties of such substances, though there is no definite evidence that they were ever used as painting mediums.

I have experimented upon three balsams: Venice turpentine,[1] Canada balsam, and the balsam of the silver pine. On testing with sulphate of copper, I found that Venice turpentine completely excluded moisture. Canada balsam did so for a long time, several weeks, but seemed to slowly yield. I have not tested oleo de abezzo in this way. When used

[1] I obtained a sample of genuine Venice turpentine with some difficulty in London. Through the kindness of the Curator of the Cambridge Botanical Gardens I obtained some larch balsams from trees there, and some balsam of the silver pine from the Black Forest.

as mediums, the addition of a very little oil, about quarter of the weight of the balsam, suffices to make it thin enough to grind colours in. Hard resins, such as amber and copal, readily dissolve in them, thus forming compound varnishes. A good picture varnish is copal dissolved in Venice turpentine and diluted with turps or with naphtha.

The oleo de abezzo is a beautiful pale yellow balsam, and forms a varnish quite equal to mastic, with, however, a slight tendency to bloom. They are all brittle when dry, but a very small admixture of oil gives the necessary toughness.

I find that carmine, ground in Venice turpentine or in oleo, with a few drops of oil, preserves its freshness wonderfully. On exposure to sunlight the purple bloom quickly goes, but after that the colour remains strong and good, while becoming a dirty brown and fading in oil or an oil varnish. I find that if verdigris in oil be exposed to sulphuretted hydrogen gas, it turns black in a few minutes, while verdigris in balsam is only very slightly affected after some hours.

There is another important property revealed by these balsams which requires some explanation. I find that certain pigments dissolve more or less readily in linseed oil. For instance, emerald green

dissolves slightly, and diffuses through the oil even after it is dry. If, for instance, emerald green is painted over dry cadmium yellow with a layer of dry oil between, it gradually passes through, and after a few months attacks the cadmium yellow and turns it black.

Verdigris is still more soluble. If warmed with linseed oil it gives a green solution. If verdigris in oil and cadmium yellow are mixed together, the action of the verdigris is so rapid that in a few hours the whole thing has turned black. Now, if instead of oil these pigments are ground in a balsam, even though a few drops of oil are mixed with it, this does not happen. A light green can be made with them perfectly well, which, as far as I have tested it, is durable.

I hold, then, that the experimental evidence is in favour of the view that these balsams were used with little admixture of oil, as mediums, in the time of Van Eyck and his immediate followers. The point to be noted is that the harder the resin, the more oil is required to dissolve it and make a fluid varnish. Consequently amber was unsuitable for the preservation of pigments such as verdigris. On the other hand, for other purposes amber may have been used. With amber, sandarac, and the balsams,

a whole range of varnishes could be easily prepared, suitable for different purposes, the first of the series containing a great deal of oil, the last being nearly pure resin. In fact, in some receipts I find the hot balsams recommended as a varnish by itself. Further evidence that at any rate the greens used by Van Eyck must have been prepared according to De Mayerne's receipt, by dissolving the verdigris in Venice turpentine (though given by him for another purpose), will be considered in the final discussion of the Van Eyck medium. Probably the use of balsam was more excessive in the Flemish pictures than in the Italian pictures meant for a drier climate.

I have no wish unduly to press the above explanation of the durability of the earlier "oil" paintings; but at any rate the experiments described both on the hardness and toughness of these varnishes and their protective power will prove for us a guide in considering more of the old receipts which I will now proceed to quote. The earliest receipts of the kind are contained in the Lucca MS. The one described as de lucide ad lucidas consists of amber, mastic, three kinds of turpentine, resin, galbanum, myrrh, two gums, and a little linseed oil, and florae puppli. Such a varnish would be very stiff and would have to be

rubbed on to the picture hot. If the turpentine resins are first fused and then the amber added before the oil, the amber would dissolve; if not, and if amber is meant, it would remain undissolved.

The next two receipts worthy of mention are those already quoted from the MS. of the monk Theophilus.

The first receipt is for the solution of a resin, probably sandarac, in linseed oil. No proportions are given and no driers are added, so that the varnish would dry very slowly. In the second receipt the resin which is called glassa (probably amber) is to be fused, and then the oil added. This may well be, therefore, a receipt for an amber varnish. The next receipt is taken from the translation by Mrs Merrifield of the MS. of Petrus de S. Audemar in the collection of MSS. by Jehan le Bègue. The MS. is probably late thirteenth or early fourteenth century. The varnishes given by Theophilus are intended to be used in gilding tin, and similarly the following receipts are for the same purpose :—

"207. *Also as before.*—Mix linseed oil and pine rosin (*pinum*), an equal weight of each, and add the same measure of vernix; put these ingredients into a jar and boil them well. Then dip leaves of tin well

varnished into it (the jar), and afterwards dry them in the sun.

"208. *Also as above.*—Put linseed oil and the inner bark of the black plum into a new jar, and boil it well for a short time upon charcoal or upon a clear fire. Then clean your glassa by weight as much as you like, and put it into another jar, and take about half the quantity of alum and of dragon's-blood, and put it all into the jar, and lastly add a little rosin (*pinum*), and melt the whole well together, and as soon as all the ingredients are melted add the above-mentioned oil, and, as if you were making a compound ointment, let them boil well together, and stir them frequently, and afterwards dip your nail into the composition and try whether it is good or not.

"209. *Also as before.*—Collect twigs of black plum, and put them in the sun for a week or a fortnight and then throw away the outer bark, and take the inner bark and put it into a rough jar, so as to fill it. Then take linseed or hempseed oil and pour into the jar as much of it as it will hold, and heat it slowly over the fire, until the bark is reduced to charcoal. Then throw away the bark, and strain the remainder of the oil through linen, and take resin and white frankincense and clean the jar well, and

then put all the ingredients into it again and heat as long as you please."

The first receipt given here would be almost solid when cold, but would do quite well to dip the tin leaves into while hot. In the second receipt the "glassa" is quite possibly amber, as it is to be fused first with the pine resin before the oil is added. This is, as has been already explained, a practicable method of dissolving amber. The third receipt is for a thickened oil to which resin is then added.

In the same collection of MSS. is included one by Johann Alcherius, written in 1388. In this only one receipt for varnish is given, in which "glasse aromatique" is to be fused, and then to one part two parts of linseed oil are to be added. This is to be spread with the fingers over dry painting. This receipt would do for amber varnish. At the same time, judging by the name, probably some other resin is intended. The next receipts for varnishes are quoted from the MS. in the Public Library at Strassburg, and which is supposed to be early fourteenth century. The translations given are by Eastlake :—[1]

"Here I will teach how to make a good varnish of

[1] Pice Greca and gloriat mean the resin left after heating the balsam of the pine and driving off the oil of turpentine. This corresponds closely to what we now call *rosin*.

three materials—a good superior varnish out of each of the materials separately. In the first place, take 1 lb. of sandarac or of mastic, whichever you please, and pulverise it in a clean mortar. Then take 3 lb. of linseed oil, or hempseed oil, or old nut oil, and boil this in a clean vessel, skimming it and taking care, above all, that it does not run over. After it has been boiled and skimmed, (throw in and) stir the powdered resin little by little in the boiling oil: thus the powder dissolves in the oil. When it is quite dissolved let the varnish seethe gently with a moderate heat, stirring it continually that it may not burn; and when you find that the composition has become thick, like melted honey, take a drop of varnish on a knife, and, after suffering it to cool a little, touch it and draw your finger slowly off; if the varnish strings it is well boiled, but, if not, boil it better till it strings. Then take it from the fire and suffer it to cool; strain it through a strong piece of linen, wringing it through the cloth into a clean glazed vessel, and keep it well covered for use. Thus you have an excellent and clear varnish of the best kind.

"And if you wish to make another good varnish, as clear and lustrous as crystal, get 1 lb. of "gloriat" (rosin) from the apothecaries' shops, and (add) twice the quantity of oil. Let them boil together, and pre-

pare this in all respects like the former varnish ; as soon as it strings it is sufficiently boiled, and is in the right state."

Similar receipts to this could easily be added from other MSS. It will be noted that in these receipts there is no mention of the use of the pine balsams, but rather of the rosin left after heating the balsam and driving off the spirits of turpentine ; there are no instructions to add driers, and that in no case is the resin dissolved in, or the varnish diluted with, oil of spike, spirits of turpentine, petroleum, or alcohol.

Such varnishes would be too stiff, or very difficult to paint with, if used as mediums without a large addition of oil, and would dry very slowly, and could only probably be used by rubbing on hot on the finished picture. They would not serve, except in some of the very highly resinous ones, to protect a pigment from change.

The absence of the mention of spirits of turpentine is very remarkable, as its preparation by distillation is described by Marcus Graccus in the eighth century, and the use either of turpentine or petroleum in varnish-making occurs in a receipt in the older part of the *Hermeneia*. The next MS. to be quoted, the MS. at Venice known as the Marciana

MS., reveals a complete change in the nature of receipts for varnishes. This MS. belongs to the sixteenth century, probably about the middle. We find here receipts for varnishes made with Gum Benzoin and alcohol. These are very weak varnishes, only suitable for paper.

There is also a receipt for making what is possibly an amber varnish; but after completion, we are directed to dilute it with linseed oil, *naphtha*, or *spirits of wine*, thus corresponding more closely to the modern oil varnish, though the actual diluents proposed are of doubtful value. Receipts are also given corresponding to those with which we are already familiar, in which sandarac, mastic, and pine resin are dissolved in linseed oil; but among them occurs the following, which is more of the nature of a spirit than an oil varnish :—

"Take one pound of mastic, half a pound of *olio petronio* (petroleum), and half an ounce of clear nut oil, and melt them together in a bottle or glass over a charcoal fire, and strain through an old linen cloth."

It is to be noted, however, that mastic does not readily dissolve in petroleum, and that therefore the question arises whether the translation of this word is correct. It is much more likely that spirits of tur-

pentine is intended, though why called "olio petronio" is difficult to explain, unless it is due to a mistake on the part of the writer of the MS.

Another receipt is for a varnish of 2 oz. clear nut oil, 1 oz. of pine resin, and ½ oz. of mastic, again corresponding pretty closely to the receipts we have already studied. The following, however, is the first receipt in which olio di abezzo (the balsam of the silver pine) is mentioned:—

"403. *Item. A varnish of 'olio di abezzo' which dries both in the sun and in the shade.*—Take 'olio di abezzo,' which must be genuine and not adulterated, and if you wish to know whether it is falsified, distemper it with nut or linseed oil, or naphtha, heating both the oils, etc., and spread it on a work, when, if it is not genuine, it will not dry for a long time, and then badly, because it is adulterated with turpentine, but if it is genuine it will dry quickly and perfectly.

"If you desire to varnish delicate works which will not be exposed to water, but merely to bring out the colours and show their beauty, distemper the olio di abezzo as above. But if you wish to varnish more permanently on works which are intended to resist water, do not distemper the olio di abezzo with other ingredients, but heat it in a vase, melt it, and varnish

with it. When you distemper it with linseed or nut oil, let it be with oil which has been exposed to the sun to evaporate, and the varnish will be much clearer."

The following receipts, taken from a MS. at Padua, probably written early in the seventeenth century, show clearly the introduction of oil of turpentine, spike oil, and naphtha.

"45. *A clear and fine varnish.*—Take of clear Venice turpentine oz. iij., and of odoriferous oil of spike oz. j., melt them well together over a slow fire, and use the varnish hot, recollecting that if you are using it on wood, you must first give it a good coat of glue, or distemper the colour with gum water, in order that the varnish may not penetrate.

"46. *A varnish which has been tried.*—Take equal parts of white mastic and linseed oil, put them into a new pipkin over a slow fire, and when the oil is hot, add to it a little 'olio d'abezzo,' and continue to mix.

"47. *Another good varnish.*—Take equal quantities of red mastic well powdered and linseed oil with a little resin; put them over the fire in a new pipkin, stirring the ingredients continually for a quarter of an hour, when it will be finished.

"48. *Another varnish.*—Take of oglio d'abezzo, naphtha, and white mastic, all at discretion; put the

whole into a new pipkin over a slow fire, and boil until all the mastic is dissolved; if there is plenty of the olio di abezzo the varnish will be better.

"49. *A varnish which dries directly.*—Take equal parts of boiled linseed oil and white mastic; place them over the fire in a new pipkin with a little oglio di abezzo; let them boil while you can say a credo; then add to them spirit of turpentine equal in quantity to half the linseed oil, mixing it well with the other ingredients.

"50. *Another varnish which dries directly.*—Put into a pipkin a proper quantity of mastic; cover it with a somewhat greater quantity of naphtha, and leave the pipkin over the hot coals until the mastic is dissolved.

"51. *A varnish which does not dry immediately.*—Take of white mastic oz. j., of nut or linseed oil oz. ij., and of oglio di abezzo oz. ss.; put the whole into a pipkin, and boil over a slow fire until all the mastic is dissolved; then add a little naphtha at discretion.

"52. *A varnish which has been proved to dry instantly.*—Take of coarsely pounded white mastic, oz. j., of spirit of turpentine, oz. j., of naphtham, oz. j., and of oglio di abezzo, oz. ij.; put all the ingredients into a glass vessel closely covered with paper; then put a tin pot over the fire, to the handle of which

the glass must be suspended, being secured to it by a string; and put into the tin pot sufficient water to cover the glass. Boil the water for half an hour, and until the mastic is dissolved, taking care not to take out the glass while the water is boiling, as it would crack.

"53. *Another varnish.*—Let any quantity of oglio di abezzo, naphtha, and mastic be placed in a pipkin in the summer and exposed to the sun, and in this way excellent varnish will be made."

If we now turn to the treatise by De Mayerne, we find very similar receipts, such as the following:—

"Oil of turpentine, 2 oz.; finest and clearest turpentine (the balsam of the larch), 1 oz.; sandarac, very little."

"Turpentine, 1 oz.; petroleum, 2 oz."

"The best varnish which resists water is made from siccative oil much thickened in the sun or with litharge."

We have found before examples of the thickened oil varnishes.

He also gives a receipt for an amber varnish which would, if capable of being made at all, be nearly black; and then tells us that the following is "the true varnish for lutes and violins." The receipt is lengthy, but can be reduced to the following:—

1st. The amber is fused and powdered.

2nd. Boil and skim the linseed oil.

3rd. Dissolve in 1 pint of the oil, 6 oz. of the fused amber.

"This varnish is used cold, and dries only in the sun."

This is a perfectly practical receipt for amber varnish, and corresponds closely to the modern method of making it in Germany.

He then goes on to state that the oil "has its fat removed" by boiling it with a piece of lead or bread crust, and to each pound a "little nut of litharge." The oil is thus a drying oil. The varnish, he says, dries in one day.

He also tells us that he found in the little *Cheirurgie* of Paracelsus a receipt for dissolving amber in "turpentine" (pine balsam). The fact that amber can be so dissolved has already been referred to; but such a varnish, while no doubt harder than a varnish of the "turpentine" alone, is no longer to be described as an amber varnish.

In his own receipt he adds to the amber, oil of turpentine first, then nut oil, then the Venice turpentine. Under these conditions the amber does not, to the best of my belief, dissolve at all.

He also has receipts, with which we are already

familiar, for dissolving the softer resins in linseed oil, and for sandarac dissolved in Venetian turpentine, and benzoin dissolved in spirits of wine.

He also tells us that the common varnish used by carpenters consisted of three parts "Greek pitch" or resin to one part of linseed oil. His receipt for varnish for leather covered with tinfoil is also already familiar: 3 lb. linseed oil, 1 lb. Greek pitch, 1 lb. sandarac, 1 oz. saffron, 1 lb. aloe resin; and he tells us that the delicate varnishes are made with petroleum, turpentine oil, and aspic oil (oil of spike).

Another interesting receipt for what he calls Chinese varnish consists of linseed oil made drying by boiling with litharge and umber, 1 pint; asphalt, 3 oz.; gum lac, 3 oz.; spiegelharz, 2 oz.; mastic, 3 oz.; dragon's-blood, 3 oz.; oil of turpentine, 1 pint.

Another receipt for amber varnish requires some of the oil to be mixed with it before melting. This, as already explained, if practicable at all, would involve practically decomposing the oil.

In another receipt by Jehan Haitier, the amber is fused and then mixed with gum lac—1 lb. of amber to $\frac{1}{4}$ lb. of gum lac,—fused, poured out, and dissolved in a drying oil, and thinned with spirits of turpentine.

In addition to these receipts he has some interesting receipts for preparing transparent pigments by grinding lake in oil of turpentine and mixing in Venice turpentine and boiling, and for dissolving verdigris in Venice turpentine. These receipts are for colouring foil for artificial jewels (doublets) and for varnishing gold.

He also describes a beautiful green varnish of verdigris, yellow lake, linseed oil, and turpentine varnish. This dissolving of verdigris in Venice turpentine has already been referred to.

The conclusion, then, that we can come to from these receipts is that the older varnishes consisted of sandarac and pine resin, and, later, mastic dissolved in linseed oil, the proportion of resin to oil being in many cases very high; that these thick varnishes were rubbed on hot with the hand; that amber varnish was also known, but must have been very dark in colour, and also varnishes in which the amber was dissolved in pine resin; that the use of oil of turpentine, spike oil, petroleum, and alcohol in preparing varnishes is not mentioned till the sixteenth century, and it is only then that the use of pine balsams is frequently mentioned; and it is only at the beginning of the seventeenth century that receipts for preparing lake with, and dissolving verdi-

gris in, pine balsam are given. When we come to consider the evidence as to the methods of oil-painting in the next chapter, we shall find that either grinding in pure oil or, after grinding in oil, the addition of a little varnish is all that is ever mentioned. It must, therefore, be plainly stated that no definite documentary evidence exists for the method of painting the Van Eyck pictures which I have suggested and will again discuss later on. On the other hand, certain curious receipts are to be found in early seventeenth-century MSS., which may be the remnants of an older tradition.

CHAPTER XIV

THE HISTORY OF THE OIL MEDIUM

HAVING dealt fully with varnishes, we can return to the history of oil-painting. As I have already stated in the chapters dealing with painting in classical times, the first mention of drying oils is made by Pliny and Dioscorides, Pliny describing the preparation of nut oil and Dioscorides adding to this the preparation of poppy oil ; but there is no indication here that the use of such oils as mediums was understood. In the sixth century Aëtius, as already stated, describes the preparation of linseed oil, and tells us that such oils can be used for varnishes, while in the Lucca Manuscript of the eighth century the first receipts for varnishes made by dissolving resins in oil appear. These receipts for varnishes have already been considered. Up to this age there is no suggestion that oil could be used as a medium for painting, and it is not until we come to the manuscript of

Theophilus—which is supposed to be of about the eleventh century, the actual copy in the British Museum having been written in the thirteenth century—that the use of oil as a painting medium is first mentioned. In chap. xx., which has already been quoted (Hendrie's translation), Theophilus says: "If you wish to redden panels, take linseed oil, which you make in this manner:—Take linseed and dry it in a pan over the fire without water, then put it in a mortar and press it with a pestle until it becomes a very fine powder; place it again in the pan and pour a little water upon it, then make this very hot. Afterwards fold it in a new cloth, and press it in a press in which olive and poppy and walnut oil are accustomed to be pressed, and this is done in the same manner. After this lightly grind minium or cinnabar upon the stone without water, and paint over the doors or tables which you wish to redden with a pencil, and you will dry them in the sun. Then paint them again, and again dry them. At last cover them over with that gluten which is called varnish, and which is made in this manner." Then follow two receipts for making varnishes. In chap. xxvii., again, Theophilus tells us all sorts of colours can be ground and laid upon woodwork with the same kind of oil, but only things which can be dried in the sun, "be-

cause each time that you have laid on one colour you cannot place another upon it until it first has dried, which for figures is excessively long and tedious." It is evident from this account that the preparation and use of linseed oil were understood at the time of Theophilus; but there is no suggestion here for either purifying and bleaching the oil or preparing a boiled or drying oil from it, and it is evident that he found the oil slow-drying. Such a raw linseed oil which had not been purified would dry slowly, and to anyone who was accustomed to painting with such mediums as gum, egg, or glue, this process of drying would seem insufferably tedious. At the same time, it is not generally known that the oil in which the artists' colours of to-day are ground is a purified but raw oil, and no driers are added, so that the rate of drying which is considered necessary by the modern artist would have been regarded as tedious in the times of Theophilus, the artist now wishing, of course, to paint into the wet surface from day to day.

The next manuscript which has a receipt for the use of oil is by Eraclius. This receipt is for the preparation of a drying oil, and is taken from Mrs Merrifield's translation, vol. i. p. 232, receipt 29, "How oil is prepared for tempering colours": "Put

a little quantity of lime into oil, and heat it, continually skimming it; add ceruse to it, according to the quantity of oil, and put it in the sun for a month or more, stirring frequently; and know that the longer it remains in the sun, the better it will be. Then strain and keep it and temper the colours with it." This receipt would produce a very satisfactory drying oil. In the first place, the treatment with lime would remove moisture and acidity; in the second place, the long exposure to the sun would remove impurities and bleach the oil, and at the same time thicken it to a certain extent and increase its rate of drying, while the presence of the white lead would make it into a rapidly drying oil. This oil, then, would be pale, somewhat thick, and quickly drying. It would have, however, one objectionable feature, and that would be the presence of a considerable amount of dissolved lead.

In the manuscript of Petrus de S. Audemar (Mrs Merrifield) there are several references to the use of oil as a medium for painting, the references being introduced as if oil was recognised as an alternative medium. This manuscript, supposed to be of about the thirteenth century, is included in a whole set of manuscripts in the Paris Library by Jehan Le Bègue, which were written out by him in 1431.

In addition to these and other references in MSS. of the twelfth and thirteenth centuries to oil-painting, there is a remarkable series of accounts existing in England in connection with the painting both at Westminster and at Ely Cathedral, of the thirteenth and fourteenth centuries, which show clearly that some kind of painting in oil was commonly practised in England at that time.

These accounts referred in many cases to the Painted Chamber at Westminster, and show that it was customary to buy oil and also to buy varnish, both red and white varnish being referred to. Similar records are found at Ely Cathedral, showing that in England, at any rate, the use of linseed oil for painting on a large scale was quite common in the thirteenth and fourteenth centuries. To take one account dealing with the Painted Chamber, we find the following items: "To Reymund for 17 pounds of white lead, ii. s.x.d.; to the same for 16 gallons of oil, xvi. s.; to the same for 24 pounds of varnish, xii. s.; to Hugo le Vespunt for 18 gallons of oil, xxi. s.; to Reymund for 100 leaves of gold, iii. s." There are also in these accounts the mention of large quantities of eggs, which certainly suggests that the method of painting must have been in some way partly tempera and partly with linseed oil.

To come now to the fifteenth century, Cennino Cennini, from whom we have already quoted, refers, as we have seen, to the use of linseed oil. In chap. lxxxix., "How to paint in oil on walls, panel, iron, or whatever you please," p. 78 of Mrs Herringham's translation, Cennino Cennini says: "Before we proceed further, I will teach you to paint in oil on walls or on panels, which is much practised by the Germans, or in the same way on iron or stone; but we will speak first of walls." In chapter xc., "How to begin painting on walls," he tells us to prepare the surface with a medium consisting of glue, egg, and the juice of the fig-tree. This is before beginning to paint with the oil. Then for painting he tells us to take 3 or 4 lb. of linseed oil, and boil the oil until it is reduced to half the quantity; and when the oil is required as a mordant for attaching gold leaf, to each pint of such thickened oil 1 oz. of vernice liquida is added. This oil of Cennino Cennini's resembles very closely the oil which is prepared to-day for lithographic inks, and would be somewhat deep yellow in colour, and thick like a varnish, but would not necessarily dry very quickly, as no driers had been introduced.

Eastlake dwells upon the use of sulphate of zinc or white vitriol as a drier. The first receipt appar-

ently in which this is mentioned is in the manuscript known as the Strassburg Manuscript, and which is supposed to be of the fifteenth century. This writer advises that oil should be boiled with calcined bones and white vitriol. It is important to note that the white copperas or sulphate of zinc of this time was impure and contained a certain amount of manganese. Pure dried sulphate of zinc has very little effect on the drying qualities of linseed oil, although, as it is hygroscopic, it may tend to remove moisture; but the impure white copperas of early times, containing manganese, would prove a very useful and valuable drier—in fact, the oil so prepared would correspond in properties to the manganese drying oils of the present day, and would have the advantage of not being acted upon by impure air owing to the absence from it of lead compounds in solution.

In this MS. directions are given for grinding colours in oil. It is advised that the colours should be ground stiffly, and that a little varnish should be added to each colour after the grinding is finished. It is evident from these quotations that, though in the case of the last one (the Strassburg Manuscript), it is possible that the information may be contemporaneous with or subsequent to the methods of the

Van Eycks, the older descriptions prove that painting with oil was understood long before the brothers Van Eyck began to paint pictures. The reference in Cennino Cennini to this being the German practice in painting is of great interest, and shows that there must have been a northern tradition, German, and also evidently English, and probably therefore Flemish, for painting with oil medium, quite distinct from the tempera tradition which we find in Italy. It is therefore rather difficult to understand the importance given to the brothers Van Eyck in the history of oil-painting, an importance which it may be remarked is very largely due to Vasari's statement in his *Lives of the Artists*, and it is remarkable that on the tombs of the Van Eycks there was no mention made of their having been the first to discover or make use of oil as a medium in painting.

We shall, however, next consider Vasari's account in *Lives of the Artists* of the discovery of this process. Of the two brothers Van Eyck, Hubert Van Eyck was the younger and Jan Van Eyck the elder brother, and of the two painters Jan Van Eyck is the more famous; but if any invention was made at all, it must have been by the younger brother, Hubert, and not by Jan. Vasari, in the first edition of his work, does not even mention Hubert,

whose name appears for the first time in the second edition. The passage taken literally ascribes the honour to Hubert, but the words are brief, and the older, more important sentence remains unaltered.

The statement made by Vasari is taken from Vasari's life of Antonello da Messina. He states: "The mode of painting in tempera which had been adopted by Cimabue about the year 1250 was followed by Giotto and those succeeding masters who had hitherto occupied our attention, and it still continued to be the only method for painting on wood and cloth." He then goes on to state that artists were aware that this medium had many disadvantages, and that the experiments to invent a better process had not been a success, neither by using liquid varnish nor other kinds of oils mixed with the tempera vehicles.

This sentence shows that emulsions of oil or varnish with the tempera had been tried. He mentions that among those who tried this experiment were Alesso Baldovinetti, Pesello, and others. Herr Berger has recently brought many arguments together with a view of trying to demonstrate that the medium used by Van Eyck was probably an emulsion of tempera with oil, and, as I shall show ultimately, I have come to the conclusion for quite other

reasons that the use of such an emulsion is not impossible as an explanation of certain of his effects, so that this reference by Vasari to attempts to use an emulsion before Van Eyck are not without interest.

He then goes on to state that while things were in this state, it happened that Giovanni of Bruges, a painter of Flanders, began to try experiments with different kinds of colour, and, being fond of alchemy, tried different oils for the composition of varnishes and other things. He then states that on a particular occasion, having finished a picture and finally varnished it, and placed it in the sun to dry, it split, and this finally decided him to try and invent a new medium. "And being not less dissatisfied with the varnish than with the process of tempera-painting, he began to devise methods for preparing a kind of varnish which should dry in the shade, so as to avoid placing his pictures in the sun. Having made experiments with many things, both pure and mixed together, at last he found that linseed and nut oil were more drying than all the rest. These, therefore, boiled with other mixtures of his, made him the varnish which he, nay, which all the painters of the world had long desired. Continuing his experiments with many other things, he saw that the immixture

of the colours with these kinds of oil gave them a firm consistence, which, when dry, was proof against wet, and moreover that the vehicle lit up the colours so beautifully, that it gave a gloss of itself without varnish. . . ." This account by Vasari has, as might be supposed, been discussed and rediscussed over and over again. At the same time, I think that possibly too much attention has been paid to it. It was written about one hundred years after Van Eyck, and it is quite obvious on the face of it, from the information we have already collected, that this romantic account of the invention of oil-painting is not based upon fact. Not only was the use of linseed oil known before Van Eyck, but, as we have shown, the purification of the oil and bleaching it in the sun, and the preparation from it of a drying oil and of a thickened oil of the nature of that used for lithographic work, was well understood. The only possible new invention in the preparation of the oil that can have been made in the fifteenth century is the use of impure sulphate of zinc, as stated in the Strassburg Manuscript. The preparation of many different kinds of varnishes from these oils was also understood. It will also be noted that the account given by Vasari is distinctly vague. He states that these oils, boiled with other mixtures of his, made him the varnish

which painters had long desired. Now, if we turn to Vasari's account of technical processes, we find that, when dealing with the subject of oil-painting, he first of all repeats briefly his statement that Giovanni of Bruges was the inventor of oil-painting, and then proceeds to tell us how oil-painting should be carried out:

"I must now explain how to set about the work. When the artist wishes to begin, that is, after he has laid the gesso on the panels or framed canvas and smoothed it, he spreads over this, with a sponge, four or five coats of the smoothest size, and proceeds to grind the colours with the walnut or linseed oil, though walnut oil is better, because it yellows less in time. When they are ground with these oils, which is their tempera, nothing else is needed, so far as the colours are concerned, but to lay them on with a brush." . . . "Vanno poi maciando i colori con olio di noci o di seme di lino (benche il noce é meglio perche ingialla meno) et cosi macinati con questi olii che é la tempera loro, non bisogno altro quanto a essi che distengergli col' penello."

I quote the Italian text here, because Herr Berger, in his *Beiträge*, vol. iii., interprets this as meaning that the oil was emulsified with a tempera

medium. It is evident, therefore, that whatever the Van Eyck medium may have been, Vasari in his day understood that the process of oil-painting consisted simply in the grinding of the colours in oil and the using of them without any other addition. At the same time, there is a suggestion in his account of the invention of his having had an impression that Van Eyck's method was somewhat different from this, since he talks about his boiling the oils *with other mixtures*, and that he wishes to suggest this, without being able himself to tell us what this other mixture was. It is, of course, possible that he wishes to conceal his knowledge; but it is, I think, more probable that he was himself uncertain on the matter, and that therefore time and attention spent in carefully weighing the words of this account are time and attention thrown away. I do not, therefore, propose to discuss the little differences between the account in the first and second editions, as they do not throw any further light on the matter.

Vasari tells us that the fame of this invention having spread throughout Italy, and a picture having been sent to Alphonso I. at Naples, it attracted great attention. "At this time one, Antonello da Messina, a person of intelligent, active spirit, and very sagacious, moreover, in his profession, having

studied drawing for many years in Rome, and having happened to go to Naples and heard of the above-mentioned picture, he went to Flanders and learned the secret from Giovanni; that he took this secret to Venice and taught it there to a certain Maestro Domenico, and from thence the knowledge spread to other painters in Italy." This account has been discussed and rediscussed, but it is unnecessary for us to dwell upon it here, as there can be no doubt that the introduction of oil-painting in Italy came through many roads, many of the leading artists who followed Van Eyck themselves going to Italy and painting pictures there.

Probably the most we can say is this, that while the use of oil for painting had been understood in Germany, in Flanders, and in England, it had not, in spite of Cennino Cennini's description of it, been seriously adopted in Italy, and that such experiments as had been made in this direction had not proved successful, and that it was not until the magnificent pictures of Jan Van Eyck were actually seen by Italian artists that the revelation of the possibilities of this medium came home to them, and that it rapidly replaced tempera as a means of painting.

It must be remembered that it is not enough

for a medium to have been proved to work. A chemist might to-morrow bring out some new painting medium which involved a somewhat different technique from that required in oil-painting, and it might possibly be superior to oil in many ways, yet he would find it difficult to persuade artists to use it, because, having already become familiar with the possibilities of oil, and having learned by long use and practice how to obtain from it certain results, they would be almost certain to reject the new medium, not because of faults in it, but because they themselves were incapable of using it efficiently. It would require a striking object-lesson to bring home to them the fact that the medium itself was an improvement on the mediums they already knew, and the defect lay in their own clumsiness in using it. After the Italian artists had once seen a picture by Giovanni, they would at once realise that oil had possibilities which were not to be found in the tempera medium, and they would be prepared to make the necessary effort to learn its use; and having once seen its possibilities as shown by Giovanni, being themselves artists, and of great technical skill, they would soon learn to imitate his effects. It is, therefore, probably safe to say that while the invention of oil-painting cannot for a mo-

ment be ascribed either to Hubert or Jan Van Eyck, to them we may give the credit of having first produced great pictures in the new medium, and of having, through their pictures, converted the Italian artists to its use.

In this discussion I have assumed the Van Eycks' method of painting to be essentially painting in oil, and not something else. This may be taken as a rough-and-ready working assumption, but, at the same time, it may require to be seriously modified before we finally accept it as proved.

An interesting description of the methods of painting adopted by Van Eyck is to be found given in verse by a Flemish painter, Van Mander, who treats the whole subject poetically in his work, *Den Grondt der Edel vry Schilder-Const.* Van Mander himself was a painter, and his son and grandson after him, though, judging by a picture by his grandson, which I have seen, the methods of Van Eyck had not been successfully handed down through the family, as it is in far from good condition.

"Our predecessors," he says, among whom he includes Van Eyck, "were in the habit of spreading a white ground over panels, more thickly than we do; they then scraped the surface as smooth as possible; they also used cartoons, which they laid on the

UNFINISHED PICTURE BY JAN VAN EYCK (ANTWERP)

Drawing on white gesso panel, with blue of sky painted in

smooth white ground and sat down and traced them, first rubbing in directly over the picture or drawing. They then drew in the design beautifully with black chalk or pencil. But an excellent method which some adopted was to grind coal black finely with water, after which they drew in and shaded their designs with all possible care; they then delicately spread over the outline a fine priming." This description of the way in which the earlier oil-painters set about making a picture is of great interest, and on the unfinished Van Eyck in the gallery at Antwerp, of which an illustration is given on p. 342, we see upon a white panel a most elaborate, complete, and detailed drawing, so that every detail of the picture has been settled before the laying on of colour takes place at all. There is no suggestion to be found in Van Mander that any particular medium other than oil was used by Van Eyck and his followers, and this work of Van Mander is the nearest that we have to the time of Van Eyck, and consequently the most likely to describe accurately the methods used by him, although, as the date is 1604, it is possible that some of his processes had been already forgotten.

Before considering in detail what the method used by Van Eyck probably consisted of, it is necessary to go a little further forward. I have already

quoted from Vasari his account of the preparation of colours in oil. In a later document which has been translated by Mrs Merrifield, and of which the author, Giovanni Batista Volpato, was born in 1633, and which consists of an imaginary dialogue between two artist's apprentices, directions are given first of all for preparing and priming of the canvas (which will be dealt with separately), and then for grinding of the colours in oil (vol. ii. p. 738). The two apprentices are supposed to be engaged in drinking wine together, and the one asks how colours are ground; the other replies that white lead, verdi eterno, indigo and all other blues, are mixed with nut oil, and other colours with linseed oil. There is here no suggestion that it is necessary to mix any other medium with the colours than linseed oil.

The directions are based on the teaching of Armenini da Faenza and Raffaello Borghini, both of the sixteenth century. It is true that Armenini, in his directions, suggests the addition of varnish to the lakes, but merely in order to hasten their drying, and not for any other object; and that Borghini, in his *Il Riposo* (1584), advises the addition of varnish to the ground colours in the following sentence: "Sopra cui calcando il cartone, o disagnando, e dando i colore, temperati con olio di noce o di linseme

(ma meglio fia di noce, perche e piu sottile, e non ingialla i colori, ne' quali fia bene mescolare cui poco di vernice) conducerete con diligenza a fine l'opera vostra, la quale non accaderà verniciarla," and also in one receipt, to the priming; but all the evidence tends to show that, in the sixteenth and seventeenth centuries, oil-painting was understood to mean painting with pigments ground in linseed oil or nut or poppy oil, and that, while the addition of varnish is suggested from time to time for various reasons, there is no evidence that the addition of varnish was considered as a necessary part of the painting process.

These remarks are necessary because the views that have been taken on this subject are influenced by Eastlake's *History of Oil-Painting*. Every possible quotation that can be brought together is brought together by him in the brilliant special pleading in which he tries to prove that the addition of varnish was regarded as an essential part of the painting process by Van Eyck and those that followed after him. One of these quotations has been already given—the Strassburg Manuscript—in which the addition of a few drops of varnish is advised; but if Eastlake's account of this matter is read critically, it will be obvious that there is really no evidence

that the addition of varnish was regarded as an essential part of the painting process—in fact, in order to try and prove that Van Dyck used such a medium, he quotes from a manuscript of unknown origin which is really of no authority at all, and which describes the preparation of megilp, and states that Van Dyck mixed his dry pigments with this, in direct contradiction to De Mayerne's statements.[1]

To continue the consideration of late sixteenth and early seventeenth century painters. We have a good deal of information about the methods adopted by Rubens, owing to *The Maxims of Rubens*, by Descamps, his own letters, and the notes by De Mayerne.

Rubens seems to have painted on white grounds, and on these, according to Descamps, painted with transparent shadows and solid lights. He preferred

[1] There is one interesting reference to the use of amber varnish as a painting medium by De Mayerne, where he tells us that amber varnish (the preparation is described), one part to nut oil two parts, is rubbed over the dead colouring with a sponge, and then painted into, by Italian artists. This receipt comes through several hands, and though possibly used by some, does not shake the accumulated general evidence as to the use of oil in the usual way. It is, however, of further interest as agreeing with the practice of the P.R.B. to be described later. The amber varnish already containing oil, and then further diluted with oil and rubbed on thin, would not much darken the picture or have much protective value.

to have his pigments first ground in oil of turpentine, and must probably have mixed them with his medium as he went along. The powder colours sold by artists' colourmen to-day have usually been so ground. In painting, he dipped his brush in oil of turpentine.

"*M. Rubens, N.B.*—To make your colours spread easily and consequently unite well, and ever retain their freshness—as in the case of blues and indeed all colours—dip your brush lightly from time to time, while you paint, in clear essential oil of Venice turpentine, distilled in a water bath; then with the same brush mix your colours on the palette" (*vide* De Mayerne).

Apparently also quoting from Rubens, De Mayerne advises mixing smalt with varnish and laying it on quickly. The difficulty of using these blues in oil has already been discussed. Again he says:—

"*Rubens, N.B.*—Turpentine in time becomes arid (as the essential oil of turpentine or the petroleum evaporates) and is not proof against water. The best water-resisting varnish is made with drying oil much thickened in the sun without boiling at all."

This is a peculiarly bad receipt of Rubens, as the oil would darken and fail to protect the pigments underneath. There is no evidence, in spite of Eastlake,

that this thickened oil was Rubens' medium. His pictures are, therefore, straightforward oil pictures, as even if he used this thickened oil it would not have the mechanical or chemical effect of a dissolved resin.

The practice of Van Dyck, from the conversation recorded with De Mayerne, whom he refers to as "Sir Anthony Vandyck, Knight, a very excellent painter," was to paint in oil, but sometimes to lay on blue and green with gum water, first rubbing on garlic and thin varnish on the top. It is also evident from the letters of Rubens to Sir Dudley Carleton and to Peiresc, that he was accustomed to put his finished pictures out in the sun, and, when they had yellowed, to bleach them in this manner.

On the whole, therefore, the evidence from the records of the sixteenth and seventeenth centuries is in favour of the view that by painting in oil was understood exactly the same process as is used to-day, and that the introduction of varnish into the medium was possibly always done by certain artists, or occasionally done in the case of certain pigments, but there was no generally accepted understanding that the introduction of the varnish was of essential importance in producing permanent works in oil. It is inconceivable, for instance, that Vasari, with his enormous experience both as a painter and his

knowledge of the history of art, would tell us so clearly that when the pigments are once ground in oil nothing else is needed, if it had been considered essential to add to the oil medium anything further. The Strassburg Manuscript, which has already been quoted, certainly advises the addition of a little varnish to each colour, but gives no reason for these additions, and is not necessarily of first-class authority in studying the methods of the Flemish school. Many receipts are given for the preparation of varnishes, but there is no proof that these were necessarily to be mixed with the colours, while Van Mander is silent on the subject. The reference to using varnish with greens, and also lakes, by Armenini, cannot be taken as conclusive evidence, especially as his reason for introducing it into the lakes is merely to make them dry quicker, so that the Strassburg Manuscript and Borghini stand alone. We must therefore come to the conclusion that the addition of varnish was not considered essential.

The attempt by Herr Berger in his recent book to prove that Van Eyck used some special emulsion of a tempera medium with oil, also breaks down as far as the evidence from books and manuscripts is concerned. The one or two references to such mixtures in the older manuscripts, and the statement

by Vasari that the attempt to use such a mixture by an Italian artist had failed, cannot be set against the negative evidence in the other direction.

It may be objected, on the other side, that, with the exception of the Strassburg Manuscript, all the other evidence quoted belongs to the sixteenth and seventeenth centuries, and that it is quite possible that by that time the special methods used by Van Eyck had been forgotten. This view is very much strengthened by an examination of the pictures painted in the Flemish school from Van Eyck onwards.

Towards the close of the sixteenth century and the beginning of the seventeenth, it is quite obvious that some technical method has been lost, the pictures being in a very bad state of preservation when compared with the Van Eyck standard; and while it may be claimed that, on the whole, the pictures of Rubens are in good condition, there can be no doubt that those by Van Dyck are very far from being in a satisfactory state. It is also of special significance to note that one of the marked features of the early oil-paintings is the magnificent greens to be seen in the drapery, and these greens, in Van Eyck's pictures, are as bright as possible. It is a marked characteristic of the Dutch painters of the close of

the sixteenth and of the seventeenth and eighteenth centuries that their greens are fugitive, and have faded to dull browns and dingy greys in a very large number of cases. This distinctly suggests either a change in the pigments or a change in the method of using them. Those who hold, therefore, that Van Eyck and his immediate followers had certain methods which resulted in their pictures having a higher standard of durability than those that followed after them have certainly a great deal in their favour. We may take it, however, as sufficiently proved by the quotations from Vasari and others, that in the sixteenth and seventeenth centuries there was no special medium used beyond ordinary oil, and that where varnish happened to be introduced it was due more to accident than to a definite plan, while, on the other hand, the finished pictures were probably, in most cases, varnished.

Pigments of the Sixteenth and Seventeenth Centuries

During the period we are now considering, from the time of the MS. by Cennino Cennini to that of De Mayerne, a few changes had taken place in the pigments used by artists, though on the whole the pigments in use remained very much the same.

Cennino Cennini only mentions two blues, real ultramarine and the copper carbonate or azurite, the blue copper ore, which was also used in the time of Pliny. He makes no mention of a copper frit like the old Egyptian blue, and, judging by the absence of its mention here and in earlier MSS., its manufacture seems to have died out. On the other hand, Professor Middleton tells us in his work on illuminated manuscripts that he has often recognised it in initial letters, so that it is possible it was still known, though not mentioned by Cennino Cennini.

In the sixteenth and seventeenth centuries, however, there are frequent references to "smalt."

Borghini, for instance, in his *Il Riposo*, published in 1584, speaks of an azzurro di smalto, which he tells us is a glass.

It is also mentioned by Lomazzo, whose treatise was translated into English by the physician Haydock, under the title, "A Tracte containing the Arts of Curious Painting, Carving, and Building, written first in Italian by Paul Lomaticus, painter of Milan, and Englished by R. H., student of Physicke, 1598." It is also mentioned by Leonardo da Vinci and by De Mayerne and others.

This pigment seems to have come from Germany.

The modern smalt was a glass prepared in Germany, which owed its colouring matter to cobalt. We have already seen that while cobalt was used from the earliest times to make a blue glaze, copper was also used, and the copper frit was prepared for a pigment. As I have shown, there is apparently a gap when such frits were unknown, and then in the sixteenth century smalt appears as a well-known pigment, but whether prepared with cobalt from the beginning instead of copper seems to be unknown, though ultimately becoming certainly a cobalt blue. It was difficult to use in oil-painting from its coarseness and glassy, gritty nature, and consequently was sometimes put on with size, or dusted on dry. If size was used, it was the universal custom to rub over the surface of the oil with garlic. This, to judge by long tradition, ensures a successful binding of the two media together.

Besides these blues, there can be little doubt that other artificial copper blues began to appear in the market.

Many receipts are given in the MSS. already repeatedly referred to for "artificial azures." To discuss these receipts in detail would be unprofitable, but they can be classified into receipts for the preparation of blue by the action of a chloride on

verdigris under a gentle heat; by the action of vinegar, and sometimes other ingredients, on plates of silver, dissolving out no doubt the alloyed copper; and by the action of lime and salammoniac on copper salts, and into receipts that would by no possibility give a blue at all.

This lime receipt was the basis of a very considerable manufacture of a blue made in England known as blue ashes, lime blue, copper blue, and mountain blue. This English process consisted of precipitating copper sulphate with potassium carbonate and grinding it with lime and salammoniac, thus copying closely the medieval receipts.

In De Mayerne's MS. there are frequent references to cendre d'azur or beis. How far this blue was still the native carbonate of copper or the artificial variety it is of course difficult to say, though doubtless a microscopic examination of the surface of a picture would make it possible to identify the ground mineral. Whether this manufacture is still carried on in England I am unable to say. The blues with which modern artists are familiar are all of much later invention.

Prussian blue and its variations, such as Antwerp blue, was invented in 1720. Cobalt and cerulean blue and artificial ultramarine are all comparatively

recent inventions of modern chemistry. The oil-painters of the sixteenth and seventeenth centuries were much hampered by the difficulties in handling the blues which were then available.

In greens nothing new was discovered, but it is evident from De Mayerne that the Flemish painters of his time made their greens usually by mixing blue with yellow lake. They seem to have had the utmost confidence in the yellow lakes, which could never have been used except for illuminating in the time of Van Eyck, with the disastrous result in the fading of their greens, which is so marked a feature of Flemish and Dutch pictures of the late sixteenth and seventeenth centuries.

Verdigris, De Mayerne says, must be glazed on by itself and protected with varnish. The receipts for verdigris dissolved in balsam which he gives are not intended for use by painters, though possibly the last of an old tradition. The protection by varnish on top would be of little or no value.

The only other pigment of importance which begins to appear above the horizon is asphaltum. De Mayerne does not give it in his list of pigments for painting in oil, which I shall shortly quote in full, but mentions it elsewhere in his MS., and describes how to dissolve it in oil.

Lomazzo states (1584) that it was used to give brightness to light and chestnut hair; and in the MS. at the library in Padua, from which some receipts for varnish have already been quoted, and which is either late sixteenth or early seventeenth century, it is stated that it is to be used for shadows in flesh, mixed with umber and burnt terre verte; while it is frequently referred to by later writers.

Eastlake is of the opinion that it was freely used by Flemish painters, and according to Mrs Merrifield the picture restorers hold that it was freely used in Italy for glazing. It must be remembered, however, that Eastlake wrote when the asphaltum craze, which has ruined so many of the pictures painted in his time, was in full swing, and that the opinion of picture restorers is not of great value. There is no evidence of any special precaution being taken in its preparation, and it is probable, therefore, that if freely used the same results would have followed as followed later. If strongly baked it becomes harmless, but at the same time loses all its finest characteristics.

Marcucci, however, gives a receipt which is very similar to one given in Riffault's *Colours for Painting*, in which the bitumen is dissolved in Venice turpentine. This, it will be remembered, was suggested

by me as possibly the varnish used by Apelles. Whether bitumen so treated loses its property of flowing is worth trying.

The palette given by De Mayerne is as follows :— White lead, black chalk (lampblack, coal-black, black of vine charcoal *on the margin*), lac, vermilion, English brown, yellow ochre (Prussian ochre, very beautiful), yellow lake, massicot, smalt, cendre d'azur, ultramarine, umber, green earth (*probably terre verte, possibly a copper green ore*), verdigris (for glazing only), minium (red lead, condemned as fugitive), indigo (no use in oil). The other lists of pigments quoted by him are very similar, and if the "lac" is a madder lake, and the verdigris dissolved in varnish, are very good except for the fatal introduction of the yellow lake.

The Preparation of Grounds

The early oil pictures, like the tempera pictures, were painted on panels carefully coated with pure white gesso. This gesso was evidently prepared so as to be either non-absorbent or very slightly absorbent, and on this the drawing of the picture was made. This is clearly shown in the unfinished Van Eyck in the Antwerp Gallery, of which a reproduction is given at p. 342. In this picture the blue sky

has been painted in, but the rest consists of a very fine drawing on the white gesso. Over this, according to Van Mander, a thin flesh-coloured priming, through which the drawing could be seen, was passed. This priming was of oil. The introduction of canvas made of course the gesso priming unsuitable, as it would be apt to crack off when the canvas was rolled up, and would be easily caused to peel off by exposure to damp from the back of the canvas.

Nevertheless, if picture restorers are to be believed, such gesso primings were long used after the introduction of canvas, and were usually treated with a sufficient proportion of size to make them non-absorbent. Such primings have been reintroduced again by the late Sir G. F. Watts. They give the advantage of a pure white background to the picture, which is unaffected by time and age, but have obvious disadvantages for a climate like ours. From the accounts left of the methods of priming adopted in the sixteenth century, it is evident that there was no consistent plan.

To deal first with the statements made by Vasari in his technical introduction to the *Lives of the Artists*, we find the following, which has been partially quoted already :—

" How to prime the panel or canvas

" I must now explain how to set about the work. When the artist wishes to begin, that is, after he has laid the gesso on the panels or framed canvases and smoothed it, he spreads over this, with a sponge, four or five coats of the smoothest size, and proceeds to grind the colours with walnut or linseed oil, though walnut oil is better, because it yellows less with time. When they are ground with these oils, which is their tempera (medium), nothing else is needed, so far as the colours are concerned, but to lay them on with a brush. But first there must be made a composition of pigments which possess seccative qualities, as white lead, driers, and earth such as is used for bells, all thoroughly well mixed together and of one tint, and when the size is dry this must be plastered over the panel and then beaten with the palm of the hand, so that it becomes evenly united and spread all over, and this many call the ' imprimatura ' (priming)."

This translation is quoted from the edition of *Vasari on Technique*, by Louisa S. Maclehose, edited by Professor Baldwin Brown. It will be noted here that the gesso ground on panel or canvas is rendered non-absorbent by means of size. On this is spread a priming.

Then follows another receipt for preparing canvas alone, which is as follows :—

"*Painting on canvas*

"In order to be able to convey pictures from one place to another, men have invented the convenient method of painting on canvas, which is of little weight, and when rolled up is easy to transport. Unless these canvases intended for oil-painting are to remain stationary, they are not covered with gesso, which would interfere with their flexibility, seeing that the gesso would crack if they were rolled up. A paste, however, is made of flour and walnut oil, with two or three measures of white lead put into it, and after the canvas has been covered from one side to the other with three or four coats of smooth size, this paste is spread on by means of a knife, and all the holes come to be filled up by the hand of the artist. That done, he gives it one or two more coats of soft size, and then the composition of priming. In order to paint on it afterwards he follows the same method as has been described above for the other processes."

This receipt is curiously complicated, with the first treatment with white lead, oil, and starch followed up by size, and then a final white lead priming.

15TH CENTURY GERMAN "OIL" PAINTING

Whole picture in perfect condition. Notice especially the brilliancy and richness of Red and Green in central figure. (Nat. Gall. Edin.)

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There is some doubt as to the nature of the "earth for bells" referred to.

It is impossible to say from this account whether the oil priming was dark in colour. It contained an unknown amount of white lead, and of "the earth used for bells" ("terre de campani"). This moulding clay or earth may have been of the nature of a white china clay.

Giovanni Battista Armenini was born in Faenza about 1530, and was trained as a painter, but ultimately became a monk. In 1586 his treatise, *De' veri Precetti della Pittura*, was published. He states that before sizing, the holes in the canvas can be filled up with flour paste and one-third white lead, and that the canvas should be sized both back and front. This is apparently, therefore, different from Vasari's statement, though it looks suspiciously like the same receipt incorrectly described either by the one author or the other. The priming is to be composed of white lead, giallorino, terra de campani, or of verdigris, white lead, and umber. The first receipt is evidently the same as Vasari's. The additions of verdigris and umber in the second receipt are as driers, and the amount added may have been very small, so as merely to tint the white. He himself advises a priming of a light flesh or flame

colour, which he brings about by the addition of varnish. He states that pictures with dark grounds ultimately darken, and that the oil in the ground darkens and sullies the colours, and therefore those who wished to prevent change made their grounds of white lead with one-sixth part varnish and a little red.

With these receipts may be compared those given by De Mayerne :—

"After spreading your canvas on a frame, give it some glue or scrap of leather of size. . . . When the glue is dry, prime quite lightly with brown-red or dark English-red. Leave to dry; smooth with pumice stone. Then prime with a second and last layer with white lead, carefully chosen charcoal, small coals, and a little umber, that it may dry more quickly. A third layer may be given, but two are sufficient."

This would doubtless produce a grey priming. It is evident from the introduction of moulding clay by Vasari, and the use of a red-ochre clay by Wallon, who supplied this receipt, that there was some fear of a pure white lead priming, at any rate in direct contact with the size.

Abraham Latombé of Amsterdam supplies this receipt :—

"Canvases must first be glued with calf- or goat-skin glue: the whole artifice consists in this. For if the glue is too strong the canvas easily splits and tears. After putting the glue on the canvas, lay it while still damp on marble, flatten with the rubber all joins and knots; then let it dry. Then prime with white lead and a *little umber*. One priming is sufficient, but if you give two layers the canvas will be more even. In painting landscapes let your priming be very light in colour."

De Mayerne comments on this that he found the colour separated from the canvas in a picture by this artist which had been hanging on a damp wall. He therefore objects to size and also to umber.

In another part of the MS., which contains the receipt of "the little painter of M. de St Jehan," after sizing we are directed to prime with bole, $\frac{1}{2}$ lb., and umber, 2 oz.; grind with oil. When dry, prime with 1 lb. white lead to 1 oz. umber. This would give a light grey priming.

It is evident from all these receipts that the canvas was first prepared with size; that sometimes the holes were filled up with flour paste and white lead, or flour, white lead, and oil (some obscurity here); that the priming was white lead with a drier like umber, and sometimes varnish, either mixed with

a clay-like substance (Vasari, Armenini), or underlaid with a priming of a clay-like substance (bole, De Mayerne); that the priming was white, light grey, or brightly tinted, of a flame-colour; that Armenini regarded the white as of great importance. It also seems that white lead and oil alone in direct contact with the sized canvas was not considered safe. Some modern receipts consist of mixtures of white lead and china clay, probably a very sound practice.

In later times darker and darker grounds were used, so that we have a transition from the pure white gesso ground on panel of Van Eyck to dark grounds on canvas. How far the colour of the ground ultimately affects the brilliancy of the picture must, I think, still be regarded as an open question, though I am disposed to favour the view that it is of importance—that, in fact, the translucency of a painted surface gradually increases, and therefore it is as well to have nothing below white but white, while in the shadows, as the oil darkens, the increased translucency will tend to correct this, because of the white panel below. The whole matter requires, however, careful testing by experiment. To look for a moment at some recent pictures: in spite of the ruin caused by asphaltum, the high lights in Wilkie's pic-

tures and bright colouring are remarkably fresh and brilliant, at any rate in his earlier works, most of which are painted on a white panel. His best unfinished picture, for instance, in the Scottish National Gallery, is a large panel with a beautiful white surface, on which the whole scheme has been sketched. On this a few heads are already painted in, and are completely finished, and as fresh and brilliant as when first executed, and are presumably free from the asphaltum with which he ruined most of his work. The mastic varnish he used so freely as a medium along with oil has in many cases resulted in fine square cracking, but seems to have done no other harm. The Pre-Raphaelite Brethren were also in favour of white grounds (Mr Holman Hunt's *Pre-Raphaelite Brotherhood*), and their pictures, to be again referred to, are in splendid preservation.

Having now got a clear conception of the materials used by painters in the sixteenth and seventeenth centuries, the question recurs whether the earlier "oil" pictures by Van Eyck and his followers were not really painted in a somewhat different medium, although the evidence from MSS. does not support this view. We have already demonstrated by means of experiments, in the first place, that spirit varnishes are brittle and much less durable when subjected to

mechanical injury than varnishes made with oil, and that of those oil varnishes the most durable are those made with the hardest resins, while oil varnishes made with mastic or with the resin of the pine, or probably even with sandarac, are not nearly so tough and hard as those from copal and possibly the genuine amber varnish. We have further demonstrated that it is a mistake to suppose that oil, whether raw, boiled, or specially thickened, is not permeable to moisture, and that oil varnishes are subject to the same defect; while the only varnishes which really exclude moisture, and so protect the pigments from change, are either spirit varnishes, or the balsams produced direct from the tree. We are thus on the horns of a dilemma, because if we wish to paint a picture with fugitive pigments, we should have to use as a medium some such material as Canada balsam or mastic dissolved in turpentine, such a picture being very easily injured mechanically, the brittle surface cracking away, though, on the other hand, there is no reason to suppose that it would not resist for a long time a chemical change. In this matter tests out of doors are probably quite unsatisfactory, as most varnishes are subjected to conditions which are very different from those within a building, and it is at any rate very probable that a pure resin

is in itself very durable, and would remain for hundreds of years without change. This, in fact, is fairly well proved by the balsam varnishes found upon the coffins of the XIXth dynasty. But such a picture would be so fragile that even if painted on panel it could not be trusted to stand for any great length of time.

On the other hand, if we wish to prepare the picture which would have the surface which would stand best against mechanical injury, we should make use of a varnish from the hardest resins, dissolved in oil, such as copal or kauri. In doing this we should have thrown away the protective value of the varnish for the pigment beneath; and as the harder the resin, the larger the amount of oil required to keep it, so the further we depart from the soft resins, the less will the varnish protect the pigments below.

This dilemma was solved by the older coach-painters by laying in the colours, for, let us say, a crest or coat-of-arms painted on the coach, with a large quantity of turpentine, so that the colours dried dead upon the surface; these colours were then protected by means of a spirit varnish which was laid on and rubbed down more than once, and then over this spirit varnish was laid an

oil copal varnish, in order to protect the brittle spirit varnish beneath. When it is remembered that the coloured coat-of-arms on a coach is constantly exposed out of doors to sun and air and all kinds of ill-usage, it is remarkable how well it lasts. Few pictures could stand long such severe treatment.

It is therefore possible that the earlier oil-painters understood this, and made use of some such complex process, and I have myself suggested this among other possible explanations. If, for instance, we took a wooden panel, and, having coated it with gesso, proceeded to paint upon it in tempera our solid colouring, and then laid on our transparent colours ground in spirit varnish, and finally, when the picture was dry, varnished it with a hard copal carriage varnish, we should certainly produce a work which in some ways would be very permanent.

When I first suggested the idea to Mrs Herringham, she made the objection that the hard oil varnish on the top would necessarily yellow with time, and that the clearness of the whites in Van Eyck's pictures made it highly improbable that such a process had been used, and this objection is, I think, a sound one.

A certain amount of further light, however, is

thrown upon the matter by an inquiry into the magnificent greens which are to be found in Van Eyck's draperies. We have already considered the pigments which were available at his time, and if the attempt is made to imitate one of his greens by means of a mixture of the known blues and yellows of his time, it will be found quite impossible; in fact, there is only one green that I know of which was known at his time, and which he could have used, and that is verdigris. Verdigris, when ground in oil, is a comparatively insignificant pigment, and the only way to get the full splendour out of this pigment is to dissolve it in a spirit varnish. If, for instance, we boil up verdigris with Canada balsam or Venice turpentine, or any other of these liquid pine balsams, it dissolves and forms perhaps the most beautiful transparent green which can be in any artificial way produced. Such a receipt for preparing green is given by De Mayerne, as we have already seen.

It is also to be noted that verdigris is supposed to turn black in oil, and it seems really to deserve this reputation. Professor Church, in his book on pigments, for instance, states that verdigris turns black in oil.

I prepared some of De Mayerne's green, and Professor Baldwin Brown compared it, when mixed

with orpiment and yellow ochre, with the greens in the Van Eyck at Ghent, and his opinion was that it matched them fairly well, though they were even brighter than my preparation. We may therefore at once put aside the possibility of these greens of Van Eyck's being composed of mixtures of the blues and yellows of his time.

This compels us to the conclusion that, in so far as his greens were concerned, he must have dissolved verdigris in Venice turpentine or some similar balsam, and used it upon the picture.

In the light of these experimental facts, if we were trying to-day to devise a process for painting a picture which should be of the greatest permanence with fugitive pigments and without any reference to such technical difficulties as might be involved in using the medium, or doing all that a modern artist requires for his method of painting, I think it is evident that we should have to adopt a compromise, and should have to aim at a medium which, while it contained a large proportion of resin, so as to preserve the pigments prepared with it, did not contain so large a proportion as to make it too easily injured mechanically. Such a medium has been recently experimented with by the Hon. Neville Lytton, and was suggested to him origin-

ally, I believe, by Mrs Herringham,[1] and consists of two parts of Canada balsam to one part of mastic varnish, and one part of an amber varnish which would consist probably, of course, of oil. With this medium emulsified with water he finds it possible to paint, but has not, however, actually ground his colours in this medium, but mixed it with the ordinary oil colours.

I have myself ground colours in this medium, and have found that when dry it forms a sufficiently invulnerable coat against injurious gases and moisture. White lead, for instance, ground in this medium, and then protected by a thin varnish of it on the top, remains white when plunged into sulphuretted hydrogen gas, while, when ground in oil, it is immediately blackened. We have therefore in this medium a compromise which may be regarded as in the direction of what we require. On the one hand, the resins used are soft, and therefore such a medium would not test very high upon the varnish-testing machine, but at the same time it might be quite tough and hard enough to stand the conditions to which the picture is usually ex-

[1] Mrs Herringham writes me that she obtained the receipt from an old picture restorer, and has used the medium mixed with dry pigment and a little drying oil, or even, she believes, without oil and finds it lends itself to a Van Eyck style of brush work.

posed. On the other hand, it would protect the pigments to a great extent, if not so completely as a pure balsam, from chemical action.

In the receipts for varnishes which have been quoted, it will be noted that with the occasional exception of two receipts, apparently for amber varnish, the proportions of resin to oil are very high; while in the early receipts of the seventeenth century, oil disappears as a constituent altogether, and a diluting medium like turpentine or petroleum is found instead, so that we may say that the character of ancient varnishes was to have a very high percentage of resinous matter as compared with oil, and to utilise for this purpose the softer resins. This characteristic prevails in the French varnishes to-day.

I have already pointed out that it is highly improbable that amber varnish was ever seriously used in painting. It is dark; it is a bad drier, and it runs on the picture; it has, in fact, all the worst faults that a painter's varnish could have, and it is also highly probable that the ordinary amber varnish bought from the shops was not made from amber at all.

I think that there is this to be said in favour of Eastlake's theory, that, while the evidence in favour of the use of varnishes in painting collected by him is of the thinnest, yet that he was more or less on

the right lines, but owing to his wish to use hard resin, if possible, he directs the attention of the reader the wrong way, because the harder the resin, the larger proportion of oil and the less the chemical protective value of the medium.

We have to search in the other direction, as the earlier habits of oil-painting consisted in using a very large proportion of such soft resinous material as Venice turpentine, and resins such as mastic and sandarac, rather than utilising a larger proportion of oil with the harder resins. It is quite easy to understand how such a method might gradually get modified almost unconsciously by the artist. The pictures of the time of Van Eyck are painted with a minute accuracy and exactness which require certainly a medium which will lie where the brush has placed it, but does not necessitate great freedom of working, or the working of one colour into another being carried out.[1] As the use of oil mediums became more familiar, and as their possibilities were realised, it would be found convenient to diminish more and more the addition of resinous material, and to approach more and more nearly to the pure oil. Yet, at a time when the chemistry of these things was not understood,

[1] Another argument in favour of this view is the curious raised surface of the dark portions in the early 'oil' pictures.

such changes would be made without realising their full significance, so that a writer of the sixteenth century who had already got familiar with the idea of a pure oil medium would naturally ascribe such a medium to the earlier painters, although, it has already been pointed out that Vasari seems to have had some doubts, from his cautiously ambiguous statement. It is evident that, up to the introduction of oil-painting, the tradition of hundreds of years, if not still longer periods, lay behind painting in tempera and every part of the process had been thoroughly worked out and understood; but from the introduction of 'oil' at the beginning of the fifteenth century, we seem to see the beginning of a breaking away from tradition; while, when we come to the sixteenth-century writers, it is already evident that rules have disappeared, whether we consider their accounts of pigments, of mediums, or of the preparation of the ground on which the painting is to be done. The many experiments tried by Leonardo da Vinci and the information in the De Mayerne MS. may be taken as a further proof of this; while, by the time we come to the later seventeenth century, pictures are becoming less and less durable and are suffering more from changes due to time. The introduction of oil-painting was like the Reformation.

It broke away from tradition and left each painter more or less free to follow his own devices. We must therefore not be surprised if it is difficult to get accurate information as to earlier methods in the breaking up of this traditional school.

The further question remains how far the Van Eycks are really to be regarded as tempera pictures. If we believe the solid painting to be done in tempera and the pigments to be glazed in oil or varnish on the top, we have to explain the fact that these glazed pigments have not scaled off. It has already been noted that the tempera pictures of the Italian school were varnished, and that this varnish is in most cases peeling off and disappearing, leaving the picture beneath uninjured. We should therefore have expected something of the same kind to happen with the Van Eycks. The only answer to this is, I think, that to a certain extent an emulsion was made use of, at any rate in some stage of the painting. The experiments that I have made myself with an emulsion of Canada balsam and white of egg prove that this is a medium which works freely under the brush, and has none of the stickiness which the highly resinous medium would otherwise have; while, if the amount of egg introduced is not too great, the final surface is hard and transparent—a result which I

certainly did not expect. There would be no difficulty with this medium in laying on firm touches with the brush, which would remain in position. On the other hand, it dries, of course, much more quickly than an oil medium alone would do. The experiments made by Herr Berger on such emulsions may here be considered. It is unfortunate that, in his anxiety to prove that such mediums were used by Van Eyck, he presses unduly the meaning of various quotations; but if allowance is made for this, his experiments on these emulsions will be found of considerable interest, and worthy of study. It has already been noted that white of egg emulsifies a Canada balsam medium, thus making it easy to manage, and therefore it is quite possible that the difficulty of using a sticky, resinous medium was overcome by emulsifying it with white of egg. If this was done, the earlier part of the picture might be painted in pure egg, the emulsified medium used above this, and possibly finished with pure varnish. In this way the danger of the scaling off of the varnish from the tempera beneath would be removed, as each stage of the picture would be firmly attached to the next.

There are, however, other points to be considered when we are discussing the relative merits of a highly

resinous medium with pure oil. I have recently examined very carefully some surfaces painted by me some fifteen years ago, of white lead and zinc white mixed with oil, and with oil and copal varnish, and with oil, copal varnish, and turpentine. The results of this examination were to show that in the case of white lead the tone had fallen very considerably, owing, evidently, to chemical action upon the white lead itself. In the case of the zinc white, the painting, which consisted of oil and copal varnish, had perfectly kept its colour, after being washed with a sponge and a little water, while the zinc white, ground with oil, without copal varnish, had very much lowered in tone. To the eye there seemed to be a general greyness upon the surface ; but when examined under the microscope, it was evident at once that this lowering in tone was simply due to dirt, for the whole surface of the oil was microscopically rough, and the dirt collected in the little microscopic hollows, and apparently had become attached to the oil itself, so that no ordinary washing could remove it, the only possible method of cleaning being the use of an alkali, which will clean off the top skin of oil as well. On the other hand, the surface painted with oil and copal varnish, although the roughest brush-work had been used, was, when

examined under the microscope, smooth and glossy, and provided no refuge for dust and dirt. It has not been sufficiently realised that the lowering in tone of oil pictures is largely due to the collection of dust on the porous surface of the oil, and the attachment of this dust firmly to the oil surface. The fact that the introduction of a varnish like copal varnish into the oil prevents this from happening is, I think, of the utmost significance. We have here, therefore, another argument in favour of a highly resinous vehicle. It is difficult to resist the conclusion, when we consider the surface appearance of the early oil pictures and their condition of preservation, and the brilliant greens which are untouched by time (the probable nature of which I have already described), that the medium used by them was a highly resinous one, though it further involved use of the softer resins; and that probably, the importance of this highly resinous medium not being realised, it was gradually allowed to be diminished more and more, and at last finally was only added by certain artists, or to certain pigments, without any particular reason, the varnishing of a picture being taken to replace the use of a resin in the oil. Such varnishes were, necessarily, insufficient to protect the pigments from the action of moisture or injurious

gases, and if prepared, as described by the 16th- and 17th-century artists, would quickly perish and leave the surface of the picture beneath exposed to the dirt.

This is not the place to discuss the condition of modern pictures, or the methods of painting adopted by modern artists, but one or two remarks on the subject may be allowed.

The difficulty is to obtain a medium which is sufficiently durable in itself and will sufficiently protect the pictures, and yet allow the free handling required by the modern artist, and painting over and painting in.

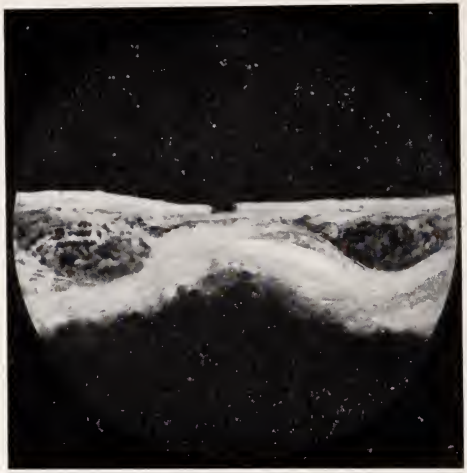
All evidence is in favour of the importance of starting from a pure white and working up to dark, of painting directly and finally with as few over-paintings as possible, and using a vehicle with at any rate a considerable percentage of a hard resin in it. Such a medium would unfortunately be rejected by the artist of to-day, in most cases, as unfit for his work, and he would also in most cases object to painting on a white ground and putting each touch of pigment finally in place. We are not discussing here, we must remember, the æsthetic aim of modern art, or the technical conditions necessary to produce a Corot, but simply the problem of producing a good painting job.

We have seen that Wilkie painted directly and finally on a white panel, and that in spite of his introducing varnish in the worst way — that is, mixing a spirit varnish with the oil on the palette, and using asphaltum—his pictures have benefited in certain respects.

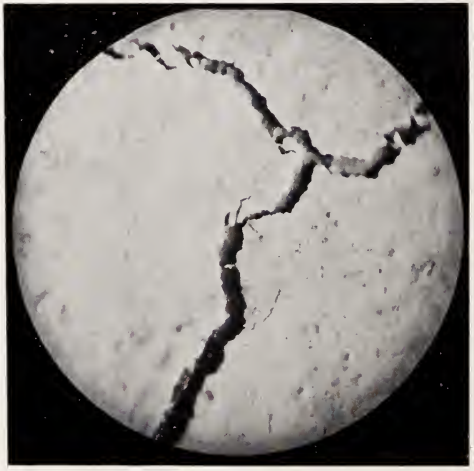
Another problem which troubles the modern artist is the occasional cracking of his pictures.

The Van Eycks are covered with very fine cracks which do not matter, and many of the later oil-paintings have cracked badly and had the cracks plastered up by the restorer (as, for instance, Titian's *Bacchus and Ariadne* in the National Gallery), but many have remained in very perfect condition. The bad effects of asphaltum, which destroyed so many early Victorian pictures, is also thoroughly recognised.

But there still remains the fact that many modern pictures crack badly though no such substance has been used. I have made many experiments without coming to a final conclusion. I have, for instance, accurately measured the contraction and expansion of canvas under changes of moisture in the air, and find it very considerable. These movements are bound ultimately to crack all oil-pictures, but the cracks may not be so marked as to spoil the pic-



MICRO-PHOTOGRAPH OF SECTION THROUGH CRACKED PICTURE



MICRO-PHOTOGRAPH OF SURFACE OF CRACKED PICTURE

tures. I have also had the opportunity of examining many modern cracked pictures, and have observed both the appearance of the surface and of a section through the crack under the microscope.

The accompanying illustrations are microphotographs of such a surface and section.

It will be noted that the crack is not V-shaped, but is a canal with straight sides revealing the ground, underneath which is in no way disturbed. It is difficult to believe that this could be caused by a shrinking of the upper painting when once it was dry, as such a shrinking would either tear or stretch the priming, and it seems more probable that it is due to an expansion of the under layers due to chemical changes going on in the not thoroughly dry oil. There is good evidence to suppose that the sixteenth- and seventeenth-century practice was to give the priming and each subsequent coat of paint plenty of time to dry, to scrape or rub down the surface, and to expose it to the sun.

Probably, therefore, hasty painting on a priming not thoroughly dry, or over painting which, while hard and therefore not mixing with the new paint, is not really dry, are the principal causes of this cracking.

But the most striking pictures of modern times,

from this point of view of producing a permanent job, are the early "Pre-Raphaelite" pictures, by Millais and Holman Hunt. These pictures give every indication of lasting for hundreds of years without change.

On page 226 of *Pre-Raphaelitism and the Pre-Raphaelite Brotherhood*, Mr Holman Hunt says:— "The process may be described thus: Select a prepared ground originally for its brightness, and renovate if necessary with fresh white when first it comes into the studio, white to be mixed with a very little amber or copal varnish. Let this last coat become of a thoroughly stone-like hardness." (It will be remembered that Armenini introduces varnish into the priming. Most modern pictures probably crack because the priming or underpainting has not thoroughly finished hardening, whether put on by the artist's colourman or by the artist.) "Upon this surface complete with exactness the outline of the part in hand. On the morning for the painting, with fresh white (from which all superfluous oil has been extracted by means of absorbent paper, and to which again a small drop of varnish has been added) spread a further coat very evenly with a palette knife over the part for the day's work, of such consistency that the drawing should

faintly shine through. In some cases the thickened white may be applied to the pieces needing brilliancy with a brush by the aid of rectified spirits. (See Van Mander's account of Van Eyck's methods.) Over this wet ground the colours (transparent and semi-transparent) should be laid with light sable brushes, and the touches must be made so tenderly that the ground below shall not be worked up, yet so far enticed to blend with the superimposed tints as to correct the qualities of thinness and staininess which over a dry ground transparent colours used would inevitably exhibit. Painting of this kind cannot be retouched, except with an entire loss of luminosity."

Again, on page 324 of the second volume, Millais, in conversation with Holman Hunt, says:— "Why, my picture of Lorenzo and Isabella is as pure and clear as any German work. You say we happened to be very lucky in our plan of painting in one coat on an absolutely *white ground* and with *copal varnish*." (The italics are mine.) He then goes on to the fortunate fact that his pigments were prepared by Field.

From these two accounts we get a complete picture of this method of painting: a white ground, a single painting on it, and the introduction of copal.

The ingenuity of the process lies in the fact that by painting with *oil* on *copal* you get rid of the trouble of a sticky copal medium, and yet work it in sufficiently to help in hardening and preserving the surface. Whether such methods can be used by the painter of to-day I do not know—that he is not thoroughly enough trained in the technical handling of his medium I sometimes suspect. Each school of painters and their admirers have their own convention for interpreting nature, and claim to be true to nature, and regard users of other conventions as swindlers, for whom hanging is too good. We are here discussing good, durable, honest painting jobs which will last uninjured for hundreds of years, if properly looked after, and among these must be placed the early pictures of the P.R.B. The slowness with which those pictures were necessarily painted, and the fact that so many were largely painted out of doors, would all help to make them permanent.

In conclusion, it may be asked of the author of this book, how, if he were asked to paint a picture to last, let us say, five hundred years, he would set about it?

My reply is, that I should first select a thoroughly seasoned panel and coat it with gesso according to Cennino Cennini's directions, and protect the back

and edges with oil-paint. The gesso ground should be non-absorbent, but not shiny with size. On this panel I would draw my picture, and then prime with oil after the directions of Van Mander. Then, taking a selected group of pigments, principally earth-colours, I would grind them in linseed oil containing some copal oil varnish, about two of oil to one of varnish. There would be no necessity to use soft resins or balsams if the pigments were wisely selected. I would not grind the pigments in oil and then use the varnish as a medium, as this produces unequal mixing. (No modern artist would paint in such a medium, I may say in passing.) With these pigments I would paint with the minute care of Van Eyck or one of the Pre-Raphaelite Brotherhood, laying each pigment where it was wanted, with no painting out, and after the first painting I would give the panel a week to dry in a bright light near a window before the next painting. As far as possible I would reduce the number of paintings laid over each other, and I would take care that where paint had to be laid over paint I was working from light to dark and that the final surface of the picture was smooth and even, with the shine of the varnish medium. Such a picture might not please as a work of art, but—it would last for ever.

A LIST OF BOOKS OF REFERENCE

THE following list of books is intended to serve as a guide to further study and research: in addition to the works cited by myself, it comprises, and brings together into one view for convenience of reference, most of the works cited by Sir Charles Eastlake, Mrs Merrifield, and Herr Berger, and it includes the leading authorities on the epoch of the Van Eycks and the question of the discovery and development of Oil Painting; but it makes no claim to consideration as a complete bibliography, more especially in regard to recent writings. It is arranged chronologically for the most important MSS. and books that are contemporary, or nearly so, with the periods covered by my book; and alphabetically for later writers and writings. I owe the suggestion of its comprehensive purview to the General Editor, Mr S. H. F. Capenny; to whom I am further indebted for good offices in the work of its compilation and revision.

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